SEP 25 1928

MACHINE TOOL EXHIBITION AT OLYMPIA.

The Engineer.

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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Machine Tool Exhibition at Olympia (Second Report). (P. 274)
THE ENGINEER, 14 - 9 - 28.

Built-up Electrical Machines. (P. 290)
THE ENGINEER, 14 - 9 - 28.

The British Association. (P. 291)
THE ENGINEER, 14 - 9 - 28.

Cableways for Nag Hammadi Barrage. (P. 284)
THE ENGINEER, 14 - 9 - 28.

Static Balancing of Rotors. (P. 285)
(HANS HEYMANN.) THE ENGINEER, 14 - 9 - 28.

Diesel-Electric Oil Tanker—No. II. (P. 294)
THE ENGINEER, 14 - 9 - 28.

The Institute of Metals—No. II. (P. 281)
THE ENGINEER, 14 - 9 - 28.

Influence of Engineering upon Civilisation. (P. 297)
(SIR WILLIAM ELLIS.) THE ENGINEER, 14 - 9 - 28.

A Summer School of Engineering. (P. 298)
THE ENGINEER, 14 - 9 - 28.

The FOURTH MACHINE TOOL & ENGINEERING EXHIBITION, OLYMPIA, SEPT. 5th-22nd.
"THE ENGINEER'S" STAND is No. 39, ROW D, at which all our Friends will be welcome.

INDEX TO ADVERTISEMENTS, PAGE 95.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
SCHEDULE 1.—140 PAIRS WHEELS and AXLES, Disc Type.
SCHEDULE 2.—28 LOCOMOTIVE ENGINES and TENDERS, 4-6-2 heavy type, 5ft. 6in. gauge.
SCHEDULE 3. COAL SCREENING PLANT.
Tenders due on the 28th September, 1928, for No. 1; on the 2nd October, 1928, for No. 2; and on the 4th October, 1928, for No. 3.
Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 9537

Assistant Engineer REQUIRED by the GOVERNMENT of the TANGANYIKA TERRITORY for the Railway Department, for a tour of 20 to 30 months' service, with possible extension. Salary £600, rising to £720 a year by annual increments of £30. An outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 35, should have passed Sections A and B of the A.M.I.C.E. examinations, or hold engineering qualifications recognised as exempting from those examinations. Must have had experience of open lines maintenance work, preferably in the Colonies, and possess a knowledge of wharf constructions and building and of reinforced concrete.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/880. 9533

Assistant Engineers (9) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT, for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. The forgoing officers are required to fill vacancies caused by the increase of the establishment of the Nigeria Public Works Department. Salary £480 a year for the first three years; then £510, rising by annual increments to £920. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 21½ years on the date of appointment, and should preferably have attained the age of 22½, and must not be over 35 years of age. Must have obtained an Engineering Degree at a recognised University or have passed Sections "A" and "B" of the A.M.I.C.E. examination, or have passed the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree or Diploma or Distinction in Engineering as may be considered satisfactory. Candidates whose qualifying diplomas have been obtained without a college course should have had three years' practical experience of Civil Engineering under a qualified Civil Engineer. It is preferred that all candidates should have had two years' practical experience on good engineering work, subsequent to taking their degree or completing their articles, but under certain conditions this may be waived in the case of candidates in possession of an Engineering Degree.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/254. 9435

Borough Polytechnic Institute,
BOROUGH-ROAD, LONDON, S.E. 1.

COMPLETE COURSES EXTENDING OVER FIVE YEARS OF EVENING WORK, LEADING TO THE ORDINARY AND HIGHER NATIONAL CERTIFICATES.

ENGINEERING SCIENCE.
PROPERTIES AND STRENGTH OF MATERIALS.
MACHINES AND HYDRAULICS.
HEAT ENGINES.
THEORY OF MACHINE AND MACHINE DESIGN.
STRUCTURAL ENGINEERING DRAWING.
STRUCTURAL STEELWORK DESIGN.
REINFORCED CONCRETE DESIGN.
HEATING AND VENTILATION.
MOTOR CAR ENGINEERING AND DESIGN.
ENGINEERS' QUANTITIES AND ESTIMATING.
PRACTICAL MATHEMATICS

ENROLMENT:
17th, 19th and 21st SEPTEMBER, 7 to 9 p.m.

Prospectus will be forwarded on application.
J. W. BISPHAM,
9384 Principal.

Chelsea Polytechnic,
MANRESA-ROAD, CHELSEA, S.W. 3.
SPECIAL CLASSES IN ENGINEERING METALLURGY.

In addition to the Courses in General Metallurgy, arrangements have been made for Special Courses of Lectures and Practical Work :—
(A) Engineering Metallurgy. Syllabus arranged to cover the syllabus of the Institution of Mechanical Engineers' Associateship Examination in Metallurgy.
(B) Heat Treatment of Metals.
(C) Testing and Mechanical Working of Metals.
The above classes are suitable for Engineers, Consultants, Engineering Students, Works Metallurgists.
COURSES BEGIN 24th SEPTEMBER, 1928.
Full details on application.
Tels., 0809 and 8007 Kensington. 9513

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, LONDON, E.C. 1.
FULL-TIME COURSES are provided as follows :—
ENGINEERING.
Courses extending four years in Civil, Mechanical, Electrical, Aeronautical, and Radio Engineering and including two summer periods in the works of industrial firms.
Matriculated students are prepared for internal degree examinations of London University.
OPHTHALMIC OPTICS.
A Course extending over two years and including preparation for the Fellowship Examinations of the British Optical Association and the Spectacle Makers' Company.
Fees from £18 per annum.—For prospectus and further information apply to
S. C. LAWS, M.A., M.Sc.,
9488 Principal.

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, LONDON, E.C. 1.
EVENING CLASSES IN ENGINEERING.
All branches of Civil, Mechanical, Electrical, Aeronautical, Automobile, and Radio Engineering.
APPLIED OPTICS.
Ophthalmic Optics, Optical Instrument Making, Optical Glass Working.
HOROLOGY. FURRIERY.
APPLIED CHEMISTRY.
Fuels, Electro-plating, Metallurgy, &c.
DOMESTIC AND ALLIED SUBJECTS.
COMMENCE SEPTEMBER 24th.
Enrolments during week commencing SEPTEMBER 17th.
Free prospectuses on application to
S. C. LAWS, M.A., M.Sc.,
9495 Principal

PUBLIC NOTICES

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, LONDON, E.C. 1.
SCHOLARSHIPS IN ENGINEERING AND OPTICS.

An EXAMINATION will be held on SEPTEMBER 19th and 20th at the Polytechnic for the Award of the following Scholarships :—
THREE SCHOLARSHIPS IN ENGINEERING, value £18 per annum.
These Scholarships are tenable at courses extending over four years in Civil, Mechanical, Electrical, Aeronautical and Radio Engineering, and including two summer periods in the works of large industrial firms.
ONE SCHOLARSHIP IN OPHTHALMIC OPTICS, value £18 per annum.
For further information apply to—
S. C. LAWS, M.A., M.Sc.,
9429 Principal.

City of Coventry. Water DEPARTMENT.
15 H.P. NATIONAL GAS ENGINE, complete with Circulating Pump, Water Tank, Exhaust Silencer Box, &c., together with SET of THREE-THROW WELL PUMPS with a capacity of from 25,000 to 30,000 gallons per hour at 50ft. total head. Belt and gear drive. In good order. Can be seen in operation by appointment. FOR SALE complete or offers will be considered for engine or pumps separate. 9511

City of Stoke-on-Trent.
CONTRACT 2831.
TENDERS are INVITED for SUPPLY of a MORTAR MILL.
Specifications and Tender forms obtainable from the City Electrical Engineer, St. George's Chambers, Kingsway, Stoke-on-Trent, on deposit of £2.
The lowest or any Tender will not necessarily be accepted.
E. B. SHARPLEY,
Town Clerk.
Town Hall, Stoke-on-Trent,
13th September, 1928. 9512

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 TO 1928.
Notice is Hereby Given that WILLIAM VOORWINDE, of No. 93b, Pretorialaan, Rotterdam, The Netherlands, SEEKS LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 290,529 in respect of an invention entitled "Improvements in and relating to Grab Buckets."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 5th September, 1928.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patent Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT,
P4940 Comptroller-General.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.—
Notice is Hereby Given that LIONEL ALFRED WHARRAD, of Cresthill Bungalow, Dagtale-road, Astwood Bank, near Redditch; LEONARD MORGAN HAINES, of Woodlands, Studley, near Alcester; and HARRY HERBERT KNOWLES, of Belmont, Maidenhead-road, Stratford-on-Avon, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 278,065 granted to them for an invention entitled "Improvements in or relating to Apparatus for Scouring Needles, Pins or the like." Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents), of the 29th August, 1928. Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.—W. S. JARRATT, Comptroller-General. 9546

Bengal Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for : 16 DECK SPAN GIRDER BRIDGES (100ft. span).
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Tuesday, 11th September, 1928.
A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Tuesday, 25th September, 1928.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
9515 Secretary.

State Electricity Commission OF VICTORIA, AUSTRALIA,
22-32, William-street,
MELBOURNE,
AUSTRALIA.
TENDERS are HEREBY INVITED for the MANUFACTURE, TESTING, SUPPLY, DELIVERY, ERECTION COMPLETE, and MAINTENANCE of STEEL CHIMNEYS and DUST ELIMINATORS for the Yallourn Power Station, in accordance with Specification No. 28/59.
Copies of Tender form, specification, drawings, &c., will be available upon application to the Agent-General for Victoria, Victoria House, The Strand, LONDON, England.
Charge £1 1s. for three copies of Tender form, conditions of tendering, specification, contract conditions and drawings complete. This charge is returnable under certain conditions as specified in the general conditions of tendering. Extra copies, 10s. 6d. each, not returnable. A preliminary deposit of £50 shall be lodged with Tender.
Tenders on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 12th November, 1928.
The Commission does not bind itself to accept the lowest or any Tender.
W. J. PRICE,
9423 Acting Secretary.

Wincanton Rural District COUNCIL.
BRUTON WATER SUPPLY.
The above Council invite TENDERS for the SUPPLYING and LAYING of about 5016 YARDS of 6in. CAST IRON MAIN and other Works incidental thereto.
Plans and specification are deposited for inspection at the office of the Engineer, Mr. H. D. Hindley, Bourton, Dorset; and also at Mr. A. J. Allen's, F.S.I., Half Moon-street, Sherborne; and at Messrs. Dyne, Hughes, Archer and Francis' Offices, Bruton.
A set of quantities may be obtained from Mr. A. J. Allen on deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.
Tenders to be delivered on or before Saturday, October 6th, sealed and endorsed "Bruton Water," and addressed to the undersigned.
Contractors will be required to provide sureties for the due performance of the contract.
The Council do not undertake to accept the lowest or any Tender, but reserve freedom of action.
By Order,
E. N. MARTIN,
Clerk to the Rural District Council.
Poor Law Office,
Wincanton, Somt.,
11th September, 1928. 9524

PUBLIC NOTICES (continued)
Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 96.
BUSINESSES and PREMISES (For Sale, etc.). Page 4.
MACHINERY, &c., WANTED, Page 3.
EDUCATIONAL, Page 3.
PATENTS, Page 4.
PARTNERSHIPS, Page 3.
AGENCIES, Page 3.
FOR SALE, Pages 4 and 96.
WORK WANTED, Page 4.
FOR HIRE, Page 3.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Biggleswade Water Supply.

MECHANICAL ENGINEER.

The Biggleswade Water Board and the Biggleswade Rural District Council invite APPLICATIONS from persons who have been trained as Mechanical Engineers for the APPOINTMENT of SUPERINTENDENT of the WATERWORKS. The person to be appointed must not exceed 40 years of age and will have to devote the whole of his time to the duties of his office, the particulars of which can be obtained from the Clerk to the above Authorities. Salary £350, increasing £25 per annum up to £450, and an allowance of £70 per annum for travelling if a motor car or motor cycle is used. The person selected will also be appointed Water Engineer for Sandy Urban District Council at a salary of £50, increasing £5 per annum to £60.

Applications, stating age and particulars of the candidates' career, with copies of three testimonials, must be delivered to the undersigned at his office at Biggleswade, Beds., on or before the 2nd day of October next. Canvassing not allowed.

HENRY CHAUNDLER,
Clerk of the Biggleswade Water Board and the
9503 Biggleswade Rural District Council.

Indian State Railways.

GREAT INDIAN PENINSULA RAILWAY.

APPLICATIONS are INVITED by letter only for the POST of POWER STATION SUPERINTENDENT for service on the above Railway. Only British subjects are eligible. The power station is situated at Kalyan, about 30 miles from Bombay. The equipment of the station comprises four 10,000-kW turbo-alternator sets and supplies current which is stepped up to 100,000 volts for transmission to railway traction sub-stations. Candidates must have had operating experience in a modern power station of similar capacity.

SALARY.—The salary including allowances will be between Rs. 825 and Rs. 1775 per mensem, depending upon candidate's qualifications. Salary will be payable from date of landing in India, subject to rules in force.

The appointment is for 3 years, but is extensible on mutual agreement.

A free first-class passage to India will be provided on appointment.

The selected candidate will be required to pass a strict medical examination and should be preferably not more than 40 years of age.

Applicants should give full details of their education and career to date and state age and salary required and whether they are married or single.

Applications, accompanied by COPIES ONLY of testimonials, should be addressed to the undersigned not later than 26th September, 1928.

MERZ & PARTNERS.
32, Victoria-street,
Westminster, London, S.W. 1. 9498

Peking-Mukden Railway.

(CHINESE GOVERNMENT RAILWAYS).

BOILER SHOP FOREMAN.—The SERVICES of a fully qualified FOREMAN are REQUIRED by the Railway in their Workshops at Tangshan. Three years' agreement. Salary £37 per month first year, £38 per month second year, £39 per month third year. Passage paid. Candidates must be in good health, and before appointment will be required to pass a medical examination. Wives and families cannot go to Tangshan until conditions there are more settled.—Applications must be made by letter, stating age, whether married or single, and giving details of education, training and experience, addressed to Messrs. SANDBERG, 40, Grosvenor-gardens, London, S.W. 1. 9534

Southwark Union.

ENGINEER'S FITTER.

The Guardians of the above-named Union invite APPLICATIONS before Noon on Monday, the 24th September, 1928, for the APPOINTMENT of a competent ENGINEER'S FITTER (with experience of Turning, Boilers, Engines, Laundry Machinery, Central Heating, Electric Lighting and Electric Lifts), at their Hospital, East Dulwich Grove, S.E. 22.

Salary at the rate of £4 10s. per week, together with working overalls.

The appointment is subject to the provisions of the Poor Law Officers' Superannuation Act, 1896.

Forms of application will be forwarded upon receipt of a stamped addressed foolscap envelope.

By Order,
A. P. STANWELL SMITH,
Clerk to the Guardians.

Union Offices,
50/51, Ufford-street,
Blackfriars-road, S.E. 1.
11th September, 1928. 9532

Sudan Government Railways

REQUIRE the SERVICES of a DISTRICT LOCOMOTIVE SUPERINTENDENT. Age 25-30, preferably single. Candidates should have been trained on a British railway or in a locomotive builder's works, and should have good knowledge of the working of a locomotive department. A.M.I.C.E. degree or equivalent. Commencing salary £E480-£E540 per annum, according to age and qualifications (£E1 equals £1 0s. 6d.). Progressive and pensionable post if satisfactory. Strict medical examination. Free first-class passage. Liberal leave and assisted passages.—Apply by letter to ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "District Locomotive Superintendent." 9517

Sudan Government Requires

the SERVICES of TWO ASSISTANT ENGINEERS for Irrigation Construction Work. Candidates should have passed the Associate Examination of the Institution of Civil Engineers or should hold an equivalent degree and have had previous experience in constructional work. The pay offered will be from £E480 to £E720 per annum, according to age and experience, for twelve months' agreement, including three months' leave. (£E1 equals £1 0s. 6d.)

Apply by letter, giving age, details of education, training and experience, to CONTROLLER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "Assistant Engineer." 9536

Trinity House, London.

APPLICATIONS are INVITED for APPOINTMENT to the POST of MARINE ENGINEER INSPECTOR in the Department of the Surveyor of Shipping and Marine Engineer on the Headquarters Staff at Trinity House.

Candidates must not be over forty years of age, must hold a Board of Trade First Class Certificate as Engineer, and have had experience in ship construction and marine engine design.

Salary £300 by £10 to £350 plus Civil Service cost-of-living bonus (at present £114 on £300).

The post (subject to twelve months' probationary service) is permanent and pensionable on the Civil Service Scale.

Applications, with copies of references and full particulars of training and experience, to be made in writing only not later than 17th October, 1928, to the SECRETARY, Trinity House, Tower Hill, London, E.C. 3, and marked outside "Application for Appointment as Marine Engineer Inspector." 9506

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED

WANTED by an Engineering Firm, REPRESENTATIVE for London and Home Counties, to assist the management in the sales of their manufactures, consisting mainly of Slow-speed Steam Engines, Iron and Steel Works Plant, and Structural Work, &c.—Address, with references, stating terms and conditions, 9490, The Engineer Office. 9490 A

WANTED, Energetic Experienced TRAVELLER; must be practical engineer, with established connection outside London area, to represent firm of manufacturing engineers in Steam Engines, Woodworking Machinery, Contractors' Plant, and General Engineering Work. Resident South or South-West England. State fullest particulars, references, age, salary.—Address, 9519, The Engineer Office. 9519 A

SITUATIONS OPEN (continued)

WANTED, for Shipbuilding Establishment in Hong Kong, ASSISTANT ENGINE WORKS MANAGER. Good training in marine engine design and construction essential; also good general and technical education. Age 28-30. Give full particulars and send copy testimonials.—Address, "ENGINE," Wm. Porteous and Co., Advertising Agents, Glasgow. P4950 A

WANTED Immediately for Spanish Colony, YOUNG Well-educated ENGINEER. Experience in levelling, pipe laying and estimating essential.—Address, P4955, The Engineer Office. P4955 A

WANTED IMMEDIATELY, YOUNG ENGINEER, age 21-25, who can prove ability and willingness to take extreme care with every detail of his work. Thorough training in workshops, drawing-office and tool-room essential. Ability to make new designs, erect small plant and organise production on time-saving basis also necessary. Good remuneration and encouragement to young man with initiative and the capacity for taking great pains with everything he does.—Address fully, stating salary required, 9438, The Engineer Office. 9438 A

WANTED, MAN of Exceptional Ability, to Eventually Take Over Entire Charge of very large Works, London, employing 3000 people; must possess big experience in modern factory organisation, be well up in all latest engineering practice and be a fully qualified engineer. Age not to exceed 40 years. Salary to begin £2000 per annum.

Address, stating fully experience and qualification, P4938, The Engineer Office. P4938 A

C.A. WANTED for Large Shipbuilding and Engineering Company in the Far East. Age 28-30. Must have good knowledge of Engineering matters. Good salary and prospects to suitable man.—Apply by letter to "C.A.," c/o Abbotts, Ltd., 32, East-cheap London, E.C. 3. P4889 A

CAPABLE WORKS MANAGER REQUIRED, to obtain maximum production from shop running Automatic Lathes.—State experience, age, and salary required to Box 307, Publicity House, 100, Fleet-street, E.C. 4. 9492 A

ENGINEER (MECHANICAL), Well Trained, with Sales and General Commercial Experience, age about 30, REQUIRED for Sales Department of Malayan Rubber Manufacturers. Healthy climate. Free single quarters. Sales Manager, now in London, will interview suitable candidates.—Write, with full details, to Box 505, c.o. Judd's, 47, Gresham-street, London, E.C. 2. 9431 A

PRACTICAL ENGINEER REQUIRED, who has specialised in the design and equipment of the latest type of Heavy Continuous Rolling Mills for the steel industry. Applicants should state age and give full details of previous experience.—Address, 9500, The Engineer Office. 9500 A

WANTED.

Metallurgical CHEMIST

Experienced in production Ferro Alloys and Metals. To act as Assistant and Take Charge of Furnaces and Chemical Analyses.

Give full particulars as to age, salary and qualifications. Confidential. Applications to be addressed to:—

"CHEMIST," Box 446, Port Elizabeth, South Africa. 9548 A

SITUATIONS OPEN (continued)

PROCESS ENGINEER and RATE FIXER REQUIRED for Electrical Instrument Factory. Must have had experience in fixing piecework prices by time study methods. Knowledge of assembly processes for small electrical apparatus essential. State experience, age, and salary required.—Address, 9510, The Engineer Office. 9510 A

REPRESENTATIVE WANTED for London, with good connection for Repairs and General Engineering Work.—Write only, stating age and experience, to BARRON'S, Ltd., 120, High-street, Tooting, S.W. 17. P4911 A

REQUIRED in a Large Motor Car Works, a First-class CHIEF JIG and TOOL DESIGNER. Applicants must be accustomed to production of high-class work at low cost and to be able to settle methods of operation, fix production times and to superintend design of tools. Only really first-class men need apply. Others will be wasting their time. Give particulars of experience, age, &c., and salary required.—Address, 9407, The Engineer Office. 9407 A

TRAVELLING REPRESENTATIVE WANTED, age 33/40, for an old-established Crane Firm; only those who are technically trained and have had previous experience need apply.—Applications should state fullest particulars, age and salary required, and be addressed to the MANAGER, Thomas Smith and Sons (Rodley), Ltd., Rodley, Leeds. 9464 A

WANTED by Consulting Engineer, West of England, young DRAUGHTSMAN with experience of Heating Lay-out and Hospital Work.—Address, stating salary required, with full details of experience, P4948, The Engineer Office. P4948 A

WANTED, by Manufacturer in London, Experienced DRAUGHTSMEN for Plenum Heating and Ventilating scheme work.—Write, Box 57, c/o Mather and Crowther, Ltd., 10/13, New Bridge-street, London, E.C. 4. 9545 A

WANTED, DRAUGHTSMAN with High-speed Diesel experience.—Address, 9520, The Engineer Office. 9520 A

WANTED, First-class DRAUGHTSMAN for Coventry district. Experienced in Machine Tool Equipment, Plant Lay-out and Operation Process.—Address, stating age, experience, and salary required, 9521, The Engineer Office. 9521 A

WANTED for Cement Machinery Manufacturers, DRAUGHTSMAN, experienced in the design of Cement Machinery and Plants. Only those with this experience need apply.—Address, giving age, salary and experience, 9489, The Engineer Office. 9489 A

DESIGNER and CHIEF DRAUGHTSMAN REQUIRED to Take Charge of Drawing-office in Works Manufacturing Accurate Machinery. Must have had considerable Machine Shop experience.—Address, stating age, experience, and salary required, 9539, The Engineer Office. 9539 A

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9529, The Engineer Office. 9529 A

DRAUGHTSMAN, Experienced in Steam Turbines and Turbo-compressors. State age, experience, and salary required.—Address, 9528, The Engineer Office. 9528 A

DRAUGHTSMAN.—WANTED, Smart Young MAN with experience and well up in theory.—State age, salary, and full particulars of training and experience to THOS. PIGGOTT and CO., Ltd., Gas, Hydraulic and General Engineers, Spring Hill, Birmingham. 9535 A

CREDIT FACILITIES

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MORE BUSINESS AND MORE MONEY.

To MAKERS of MACHINERY

because —

1. By allowing extended credit terms to your buyer, the **volume of sales** is **greatly increased**.
2. Thereby you are enabled to **increase output** and **reduce cost per unit.**
3. By **using our capital** this result is achieved **without extra expense to you.**
4. Hence the **Makers' net profits** are increased.

To USERS of MACHINERY

because —

1. By using our extended credit facilities your plant is **immediately improved.**
2. Thereby you **immediately increase output** and **reduce** cost of production.
3. The expense for using our credit is a **small part** of **your enhanced earnings.**
4. Hence the **Users' net profits are increased.**

We invite you to call and get full particulars Olympia, Stand 60 D, Sept. 5th - 22nd.

INDUSTRIAL DISCOUNT COMPANY LIMITED

6, AUSTIN FRIARS, LONDON, E.C. 2.

Telephone: London Wall 7038/9.

SITUATIONS OPEN (continued)

DRAUGHTSMAN, with Pumping Machinery Experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 9311, The Engineer Office. 9311 A

ENGINEERING DRAUGHTSMAN, with Exp. in the design of Rubber Plantation M/c and/or Hydraulic Presses, &c., REQD. in London.—Address, giving age and exp., with sal. reqd., 9538, The Engineer Office. 9538 A

FIRST-CLASS CONSTRUCTIONAL DRAUGHTSMAN WANTED, capable of designing and taking out quantities.—Address, stating experience, age, and salary required, 9542, The Engineer Office. 9542 A

FIRST-CLASS DETAIL DRAUGHTSMAN.—FAIRWEATHER and RANGER, Holborn. P4945 A

FULLY QUALIFIED DRAUGHTSMAN and DESIGNER, specialising in Steel Lattice Towers for Overhead Electrical Transmission, with practical knowledge and shop experience. State qualifications and salary required.—Address, 9514, The Engineer Office. 9514 A

NORTH-EAST COAST ENGINEERING FIRM REQUIRES ONE or MORE DRAUGHTSMEN having experience in Blast-furnace Work and By-product Plant.—Write, stating salary, experience, age, &c., Z.M. 524, c/o Deacon's, Fenchurch-avenue, E.C. 3. 9507 A

TRACER (Woman) REQUIRED for Engineer's Works, 20 miles south of London. Must be good block printer and quick. State age, experience, and salary required.—Address, 9487, The Engineer Office. 9487 A

FOREMAN WANTED for General Machine Section of large works. Experience in up-to-date methods of production essential. State age, experience and salary required.—Address, 9466, The Engineer Office. 9466 A

REQUIRED by a European Firm of Structural and General Engineers in India, an ASSISTANT FOREMAN in their Structural Department. Applicants must have experience in Template Making and be accustomed to Bridge, Roof and General Structural Work. Must be a bachelor and not more than 25 years of age.—Apply, stating age and full particulars of experience, to Z.P. 528, care Deacon's Advertising Offices, Fenchurch-avenue, London. 9509 A

OIL Company (British) Operating in Venezuela, REQUIRES FIRST-CLASS MECHANIC, capable of running and maintaining several large Internal Combustion Engines (Waukesha). Knowledge of pumping plant of advantage. Must be competent fitter and capable of doing repairs. Single man essential. Commencing salary £25 to £30 monthly, and all found; first-class fare provided.—Write, "F. H.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 9545 A

SITUATIONS WANTED

CASE-HARDENING and HEAT-TREATMENT SPECIALIST, make own carburising and anti-carburising agents, DESIRES CHANGE. Representation or Administrative Post.—Address, P4951, The Engineer Office. P4951 B

CIVIL ENGINEER, Ex-Service Man, Age 27, REQUIRES a POST on Roadmaking, Building Construction and Bridging, preferably in Great Britain. Six years' thorough experience in all branches of the above as an executive officer in Government, on contract works, which expired in May, 1928. Excellent testimonial from Chief Engineer.—Address, P4944, The Engineer Office. P4944 B

COMMERCIAL ENGINEER, Possessing Extensive business and administrative experience, home and abroad, sound technical knowledge and exceptional organising abilities, knowledge French and German, DESIRES RESPONSIBLE APPOINTMENT.—Address, P4955, The Engineer Office. P4955 B

COMMERCIAL ENGINEER WANTS to REPRESENT first-class FIRM; Continental experience, travelled Midlands; 20 years business getter and owns car.—Address, P4949, The Engineer Office. P4949 B

ENGINEER, A.M.I. Mech. E., Chief Draughtsman, SEEKS CHANGE. Wide, varied experience general engineering. Desires responsible position (not necessarily D.O.) with firm of good standing.—Address, P4942, The Engineer Office. P4942 B

ENGINEER (29) SEEKS APP. Public School education, exp. D.O. and assist. exp. in works erection and maintenance.—BM/L 024, London, W.C.1. 9508 B

EXPERIENCED FOUNDRY EFFICIENCY EXPERT DESIRES POSITION where scope for energy and ability exists. Ten years' experience in foundry planning, piecework systems, organisation, &c.—Address, P4946, The Engineer Office. P4946 B

HEATING and VENTILATING ENGINEER, with 18 years' thorough practical experience of designing and supervising work of the highest class, particularly large central installations and steam-raising plants, DESIRES RESPONSIBLE POSITION. Accustomed to handling staff. Age 35, of good education and address.—Address, P4892, The Engineer Office. P4892 B

GENERAL MANAGER (43). M.I. Mech. E., with a highly successful record in this country and abroad, has just returned from India, where he has successfully reorganised a large engineering works owned by an important British company, and is now OPEN for ENGAGEMENT where initiative, energy, tact, and high organising ability on sound financial lines are required. Has successfully controlled works employing 5000 workpeople. Is a keen disciplinarian, thoroughly capable of developing business, obtaining and maintaining efficiency.

Moderate salary required with good prospects.
Address, P4896, The Engineer Office. P4896 B

INSPECTING and MECHANICAL ENGINEER, M.I. and S. Inst., highest references, young and active, 2 years' experience Continental mills, speaks fluent French, little German, DESIRES APPOINTMENT in Australia, New Zealand, or any other country.—Address, P4841, The Engineer Office. P4841 B

MECHANICAL ENGINEER, Age 25, Public School, full workshop, drawing-office and technical experience, WISHES to IMPROVE POSITION on commercial or general side.—Address, P4939, The Engineer Office. P4939 B

MECH. ENGINEER (30) REQUIRES POST in Factory or Mill, preferably in Southern Counties. Sound experience with plant erections, repairs and maintenance. Used to control of staff. Excellent credentials.—Address, ENGINEER, 18, Wilson-street, S.W. 11. P4947 B

SALES ENGINEER, M. Inst. Mech. E., with Extensive Technical and Sales experience, WISHES to HEAR of POSITION as Sales Engineer for London and/or the Home Counties with a well-known firm.

Remuneration on commission and expenses basis, with reasonable duration of agreement.

Address, P4925, The Engineer Office. P4925 B

ENGINEERING DRAUGHTSMAN, with 20 Years' general and mechanical experience, SEEKS POST, London district.—Address, P4913, The Engineer Office. P4913 B

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

A Quarter's Wreck Returns.

THE return of wrecks which has just been published by Lloyd's Register of Shipping for the quarter ended March 31st, 1928, shows that there was during the period under review a reduction in the world's mercantile fleet, arising from all causes, whether by loss at sea or by breaking up, of 399,285 gross tons. This total includes 227 steamers, motor vessels and sailing ships, of which 117, aggregating 133,080 tons, were lost at sea, whilst 110, totalling 266,205 tons, were broken up or condemned. If the ships lost at sea be alone considered, then the proportion of British-owned vessels of all kinds is 26 out of a total of 117. America and Japan each lost 14 ships, and Germany and Norway each 10 ships. In the case of vessels which were broken up and condemned from causes known not to be consequent upon stress of weather, 17 British-owned steamers, aggregating 29,966 tons, come within this category, and in the same list there are over 55 American ships of round about 2000 to 2600 gross tons which have been broken up. The loss of steamers, motor vessels and sailing ships owned in Great Britain and Ireland expressed as a percentage of ships owned, worked out over the quarter to 0·32 per cent., or only 0·08 per cent. of the tonnage owned.

New Bridges.

A NOTABLE departure from the usual design of armoured concrete bridges is the one which has just been completed as part of the Gare de l'Est extensions in Paris. Crossing the railway its total length is about 150 m. The feature of this bridge is that it is of the continuous girder type, of uniform depth, with crossed diagonal stays and, being obviously influenced by the design of metallic bridges, there was some curiosity as to the results of the test. As a matter of fact, there appears to be more steel than concrete in the bridge, for the rods of more than usual tensile strength are packed so close together that the concrete had to be forced in between them. The appearance of the bridge is quite pleasing, because of its lattice lozenge pattern design. The bridge passed successfully through specially severe tests when the deflection was only about one-third of that allowed for safety. Armoured concrete is employed more largely for railway bridges because it is not affected by the corroding action of locomotive fumes, and the upkeep costs nothing. Test pieces of the concrete have been kept and will be tested yearly over a considerable period, in order to ascertain whether the material undergoes changes of hardness and resistance. Another important bridge which it is proposed to construct is one having a length of 1155 m., and joining the communes on each side of the Rhone at Lyons. The total width will be 25 m. There will be thirty-five arches carried on piers of masoney with spans varying from 10 m. 50 to 60 m. The bridge will have three footways, two lateral and one central. The time occupied in constructing the bridge will be from three to four years. It is hoped to build it partly with the aid of German reparations.

The Last of the Dreadnoughts.

THE battleship H.M.S. "Colossus," which is the last of the "Dreadnought" class of ships to go out of commission, arrived at Rosyth from Devonport last week, where she will be docked for breaking up. The towage of the vessel was arranged by Messrs. Douglas and Ramsay, of Glasgow, and the work was successfully accomplished by two British tugs, the "King's Cross" and the "Sampshire Batts," of Middlesbrough. The "Colossus," it may be recalled, was built at Greenock by Scott's Shipbuilding and Engineering Company, Ltd., and was launched in 1911. She took part in the Battle of Jutland and was one of the casualties of that fight. At the end of the war she was placed on the disposal list, but later, in 1922, she acted as an overflow ship to H.M.S. "Impregnable" at Devonport. After doing service for five years in that capacity she was paid off last year and placed on the sale list. Her breaking up will provide employment for a considerable number of men during the winter and work on her demolition will start soon.

Telephone Delays in London.

As a result of the fire which occurred in the cable subway under the Thames Embankment on the night of Saturday, September 1st, no fewer than eighty-five telephone junction groups and other lines were put out of use. About 900 telephone subscribers' wires on the Central Exchange, and 400 on the City Exchange were affected. Other exchanges that suffered as the result of the fire were Gerrard, Victoria, New Cross, Kensington, Regent, Riverside and Royal. All the cable companies' wires were cut off, but a temporary foreign service was soon organised. As far as possible, the position has been ameliorated by diversion of the affected portions of cables to spare cables. At the time of writing a large force of engineers is engaged on the work of restoring the telephone service, and the conditions are steadily improving, but it is feared that some time will elapse before all the lines affected will be working again. Many hundreds of junction wires have been rendered useless, and their separate identity has been obliterated by fusion. The damaged sections have to be cut away and new sections substituted, and as the work proceeds it is necessary to carry out elaborate testing operations. On Monday the Eastern Telegraph Company announced temporary difficulties in communications, and stated that some delay in telegraphic correspondence was anticipated. The fire affected the direct communications with the company's main cable station in Cornwall, and also destroyed the electric cable which supplies current for lighting the Embankment between Blackfriars and Charing Cross. On Tuesday another fire in a cable pit at Jamaica-road, Bermondsey, put a large number of circuits out of action for some time until repairs could be made.

The Shannon Power Scheme.

SPEAKING at a luncheon of the Irish Electricity Supply Board held a few days ago, Mr. McGilligan, who has profound faith in the success of the Shannon Power scheme, said that if promises were fulfilled, in a year's time current generated in Ardnacrusha would be available in the whole of Leinster, for the Leinster circuit would be the first to be completed and served. It was hoped that the works on the river above Limerick would be completed early in the spring of 1929, and that the waters would be let into the canal about June 1st. Hitherto all operations had been carried out within the scheduled time, and there was good reason to believe that Siemens-Schuckerts' promise of electricty for Leinster in the summer of 1929 would be fulfilled. The extension of the distribution system to the remainder of the Free State would, in all probability, be accomplished before the end of 1929, when the first stage of the scheme would be complete. The second stage of the scheme, Mr. McGilligan went on to explain, provided for works higher up the Shannon in the neighbourhood of Athlone, and they involved the use of Lough Ree for a reservoir. The success of the first part of the scheme, from the point of view of the consumption of electricity, would determine the date of progress with the second stage. Some 5000 men were engaged on the work, about 500 of which were Germans. The interest that foreign engineers were taking in the scheme was shown by the number of continental and overseas experts who had gone to Ireland to see the work.

A New 300 Horse-power Lathe.

FOLLOWING the reference made by Sir William Ellis in his Presidential address to the Engineering Section of the British Association last week, to the probability of the advent of a new tool steel which would call for machine tools of higher power, comes the interesting announcement that G. and A. Harvey, Ltd., of Govan, Glasgow, are to build for John Brown and Co., Ltd., of Sheffield, a 300 horse-power lathe. It is stated that although the new steel referred to by Sir William Ellis is not actually on the market yet provision is being made for its employment on the heavy lathe referred to. The 300 horse-power electric motor which will drive the new tool is said to be the largest ever used for such a purpose. The new lathe will have 42in. centres, and will accommodate lengths up to 50ft. Its weight will be about 135 tons, and there are to be four independent saddles, each operated by a 5 horse-power motor. Each saddle will have an independent feed and reverse, and will be able to work separate from the others, both in regard to feed and direction of movement. The loose head will be furnished with a motor of similar power to those to be used on the saddles. Arrangements are to be made whereby the headstock speed can be varied from one half a revolution up to 65 revolutions per minute with a cutting speed of 300ft. per minute. The rate of feed will be variable between one thirty-second of an inch and ¼in. per revolution of the work.

Fast Atlantic Liners.

ON Tuesday morning last, September 11th, the Cunard Liner "Mauretania" completed her fastest voyage from New York to Plymouth, in five days and six minutes. It will be recalled that in July last she made a record trip from Cherbourg to New York in five days three hours and seventeen minutes, while earlier in that month she did the round trip from Southampton to New York and from New York back to Plymouth in twelve days and fifteen hours. According to the new schedule of the North German Lloyd Company, the new liners "Bremen" and "Europa" will begin their service in April next. The "Europa" is scheduled to sail from Southampton on April 4th and the "Bremen" will follow a fortnight later. The scheduled passage from Southampton to New York is five days, and the liners will call at Southampton instead of Plymouth on the homeward voyage to Bremen. Since the official announcement that the gross tonnage of the new White Star Liner had been fixed at 60,000 tons, conjecture has been free regarding the other particulars, 1050ft. in length and 120ft. beam have been mentioned as probable dimensions, while it has also been suggested that the machinery will be of the quadruple screw geared turbine type, with high-pressure water-tube boilers, and that it will be designed for a probable output of 140,000 S.H.P., which it is stated might enable a speed of 27½ to 29 knots to be obtained. When an official announcement has been made concerning these particulars, it will be interesting to see whether these suggested figures accord with the facts. Meanwhile, it can be stated that both the White Star and Cunard companies are following with interest the performance of the electrically-propelled liner "California," which is doing good work in the New York–Panama Pacific service.

Pulverised Fuel for Marine Purposes.

ON the occasion of the meeting of the British Association in Glasgow last week Yarrow and Co., Ltd., of Scotstoun, opened their works to visitors, to show the progress which has been made by the firm in the burning of pulverised fuel in marine and land type boilers of the Yarrow type. A new short-flame burner of a special Yarrow design has been fitted to the works boiler and it is so arranged that from 2000 lb. to 3000 lb. of coal can be burned per hour. Valuable experiments have also been made with a furnace built in the open, which has enabled the size and form of the flame to be studied. As at present arranged fuel can be delivered to the burner from two pulverising mills. One of these is of the high-speed Alfred Herbert "Atritor" type and the other of the "Kennedy" pattern, which is a slow-speed air-swept mill of American design. The primary air, which is warmed in a tubular heater and carries the pulverised fuel, is mixed with the secondary air in such a way that a short fan-shaped flame is obtained. In the Yarrow design the centre portion of the burner is arranged to act as an aspirator, so that part of the flame is drawn back into the burner and so heats up the pulverised coal and air as it enters the furnace. In the shops the newly completed 600 lb. pressure oil-fired boilers for the turbo-electric propelled P. and O. liner the "Viceroy of India," which will be launched from the Linthouse Yard of Alexander Stephen and Son, Ltd., to-morrow, September 15th, were on view. The firm has now under construction a boiler which will work at 1200 lb. per square inch.

Co-operation in Industry.

ON Thursday of last week, September 6th, the Trades Union Congress meeting at Swansea, after a debate lasting over five hours, endorsed the reports of the Industrial Conference which had taken place between the General Council of the Trades Unions and Lord Melchett's group, and authorised its continuance. Over three million votes were given for the report and the opposition votes numbered but a little more than half a million. As a result of the emphatic endorsement of this policy of co-operation in industry by the Trades Union Congress the way has been opened, it is understood, for a further advance along the same lines, which should improve the relations between the employers and the workers. The General Council of the Unions will next address itself to the task of working out a scheme for the setting up of a National Industrial Council along with Conciliation Boards. By such means it is hoped that the causes of threatened industrial disputes may be investigated and that strikes and lock-outs may be prevented. A feature of the Swansea conference was a tendency in the direction of making the General Council the central authority for the trade union movement, which will enable it to take a more prominent part in industrial negotiations with employers.

Burrator Reservoir.

ON Wednesday last, September 12th, the Mayor of Plymouth, Councillor W. H. J. Priest, officially opened the enlarged reservoir at Burrator, which was recently completed, after four and a-half years of work. A view of the reservoir showing the heightened dam was given in THE ENGINEER of August 31st last. It may be remembered that the reservoir is formed by two dams, one the Burrator Dam, which is built of granite masonry and concrete, and the other, the Sheepstor Dam, which consists of an earth embankment, with a puddle wall above the original ground level, and a concrete tongue below ground level. By raising these two dams by 10ft. the capacity of the reservoir has been increased from 668,000,000 gallons to 1,026,000,000 gallons, and the top water area now extends to over 148 acres. The work at the Burrator Dam involved the taking down of the arches and part of the sloping walls, and building up again to the required height, with the replacement of the arches. Difficulties with underground water were experienced at the Sheepstor Dam, and it was necessary to make junctions with the old concrete tongue below the ground level, and to carry these junctions into the hill at each side with wing trenches. The work, which has cost £165,000, was carried out to the designs and under the supervision of Mr. Frank Howarth, M. Inst. C.E., the Corporation waterworks engineer, by Corporation labour, about 200 men being employed.

Machine Tool Exhibition, Olympia.

No. II.*

In our Supplement and the general pages of our last issue we described some of the exhibits at the Machine Tool and Engineering Exhibition, which closes at Olympia on September 22nd. To-day we continue these accounts.

BRITANNIA LATHE AND OIL ENGINE COMPANY, LTD.

The Britannia Lathe and Oil Engine Company, Ltd., of Colchester, are showing on their stand a useful range of lathes from 4in. to 7in. centres, which are

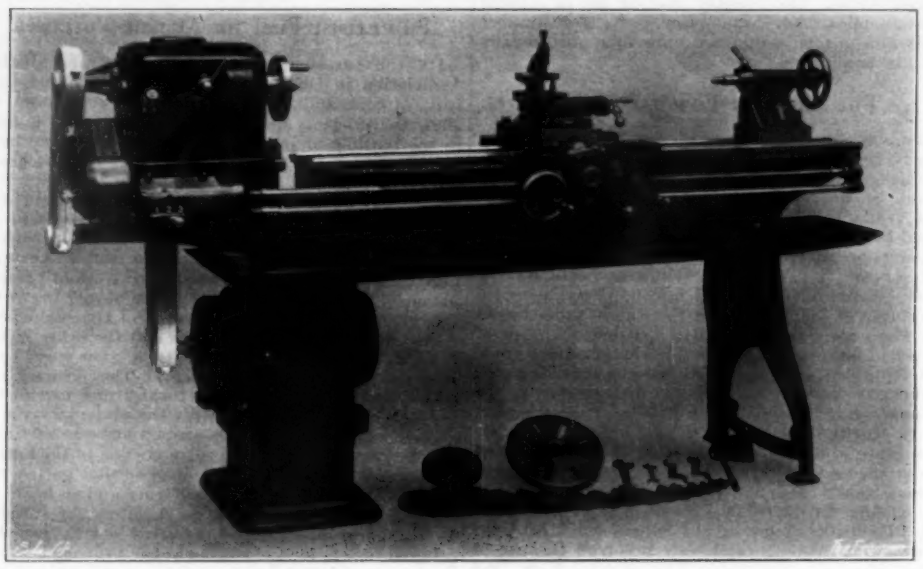

FIG. 20—GENERAL REPAIR LATHE—BRITANNIA

particularly suitable for amateur's use, general repair shops, machine shops, and motor garages, one of which is illustrated in Fig. 20. In each case the bed is of the vee design, whereon the saddle is located off only one of the vees, a separate guide being provided for the headstock and tailstock. By these means the accuracy of the lathe is maintained unimpaired after many years' wear. The spindle bearings may be either of the taper roller or adjustable conical type, but in both cases the design ensures that the alignability of the headstock and tailstock always remains constant. The change wheels are held in position by a light conical spring, which is expanded over a cone by means of a small knurled thumb-screw. Very little pressure is needed to lock the wheel in position and the use of a spanner is entirely done away with. Double nuts, which are adjustable, are used on the slide rest, and it is, therefore, possible to take up all wear by locking one nut against the other. Provision is made so that the two nuts can be locked in any desired position. Another feature is the incorporation of an adjustable toolslide by means of which the height of the tool can be raised or lowered at will. The design incorporates two inclined planes which slide upon one another, and are held rigid by means of a small milled thumb-screw. The manufacturers make the following claims for this class of toolholder:—Unlike the American type, the angle or rake of the tool is not altered when the tool is raised or lowered. Owing to the tool platform being much bigger in area the operator is able to place the cutting tool in almost any desired position. A pressed steel tray is used in preference to the older cast iron type, owing to its durability and lightness. Accessibility and ease of manipulation have been given due consideration, and the gear is so arranged that the operator can throw the lathe in and out of gear or reverse the direction of the lead screw by the use of one hand only. An innovation is the arrangement of the rack and pinion on the left-hand side of the saddle. A useful feature lies in the fact that various additions, such as self-surfacing, or Norton type, gear-box can be added to the standard lathes without alteration, and the machines are arranged to accommodate the necessary parts.

A new device has been incorporated in the design of these lathes which enables their owners to convert them into practical grinding machines. In this connection it may be pointed out that one of the great objections to the ordinary grinding attachment lies in the difficulty of moving it backwards and forwards without having an undue "dwell" at the reversing position. For this reason grinding on a lathe has not been considered satisfactory. In order to overcome this difficulty the Britannia Company has introduced a device whereby the grinding wheel is automatically moved forward and backward on the bed in any desired position. Protection is further provided to prevent any dust from lodging on the bed of the lathe and doing any damage. The wheel is driven through a small three-speed gear-box, and a really high rate of speed can be maintained, which is, of course, essential for successful grinding.

A milling attachment has also been designed more or less on standard lines with the exception that the makers have dispensed with what often proves to be a cumbersome overhead arrangement. Experience has taught that in practically all cases it is far better to drive the milling cutter between centres and to accommodate the work on the attachment itself. In this way a large variety of speeds are obtainable, and the milling cutter has considerably greater power behind it. As far as possible the nose of the milling spindle corresponds with the nose of the lathe, so that chucks, face-plate, &c., are interchangeable, and it is therefore just as simple a matter to hold the work in the milling attachment as in the lathe headstock. A division plate can be supplied if necessary, but in order to save expense the standard change wheels on the lathe can also be used for ordinary division work. A rather novel device is what the makers have termed an "extension poppet." It is really a back centre with an extended sole plate, so that it can be bolted on to the end of the lathe bed and accommodate work longer than that for which the machine was originally intended.

Another attachment is intended for winding electric coils, and with it standard coils of almost any type or length can be wound by utilising the change wheels which are supplied with the lathe. The reciprocating motion which feeds the wire to the bobbin is derived from a cam, which is operated by means of a worm wheel engaging with the leading screw of the lathe. It is possible, therefore, by altering the train of wheels to get a very large variation in conjunction with two or three different cams. There is also on this stand an electrically-driven lathe which incorporates the motor in the leg at the tailstock end with the switch so placed as to be within easy reach of the operator. There is, moreover, a clutch fitted between the motor and gearing, so that the lathe can be stopped by the operator's knee. This clutch, while not altogether essential, is distinctly useful, because it saves time in stopping and starting the machine. Further, should the operator require to employ a gauge or micrometer, he is able to use the clutch with the knee, and utilise both hands on the work. Two universal joints are used to couple the motor to the gearing. The motor is almost totally enclosed, and being placed at the tai'stock end is less liable to receive dirt or chips as is often the case when it is placed immediately under the headstock.

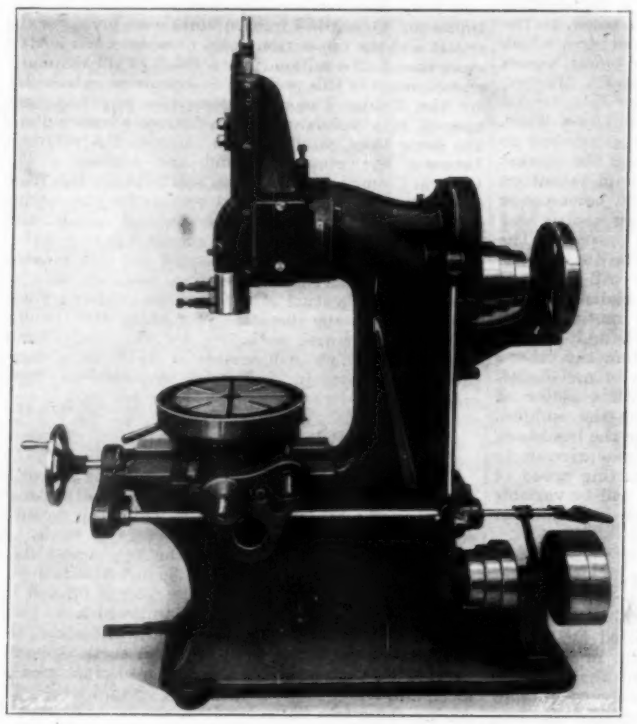

FIG. 21—SLOTTING MACHINE—ATKINS

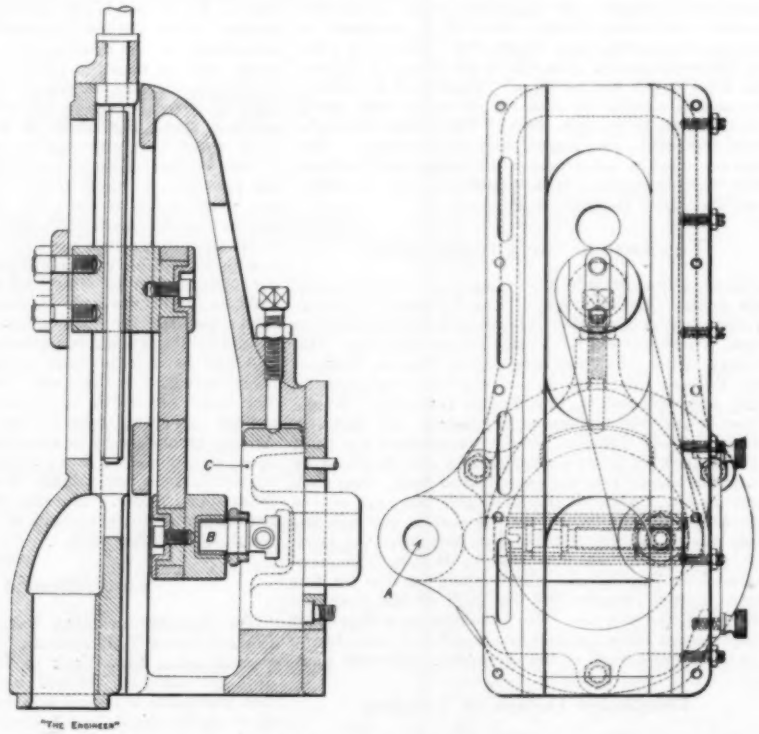

FIG. 22—QUICK RETURN MOTION—ATKINS

HARRY F. ATKINS.

The 6in. vertical shaping and slotting machine illustrated in Fig. 21 is exhibited by Mr. Harry F. Atkins, Old Fletton, Peterborough. This machine has been designed to undertake the production of small accurate parts, such as those made in a works

* No. I. appeared September 7th.

tool-room. The ram moves in a long narrow slide, and is given a quick return motion by means of a Whitworth link gear embodied within the swivelling head, with which the column is fitted. The detail design of this link gear is illustrated in Fig. 22. The link, hinged at A and coupled at its opposite end to the ram nut, is recessed on its rear face to receive the crank pin B, the radial position of which on the driving disc C can be adjusted by a screw to vary the length of the stroke. The position of the stroke is adjusted by means of the screw passing through the ram nut. The end of the ram carries a rotatable tool-box of the clapper type, which can be turned to work in any position. Several forms of interchangeable clapper boxes can be provided. Two forms are illustrated in Fig. 23. In the second form shown in this engraving, the tool is clamped by two set screws between the jaws of the hinged end piece, and therefore the box can be used to slot the interior of a hole of little more than its own diameter. A very high-speed ratio is used between the ram and the driving pulleys on the countershaft at the foot of the column. The pulleys on this shaft run at 600 r.p.m. The machine as a consequence works, it is claimed, at an exceptionally high speed, and for its size possesses a considerable amount of reserve power. The feed for the work slides is obtained from a side shaft operated by a ratchet and pawl and is transmitted from this shaft through spur and worm gearing to the longitudinal and transverse feed screws, and to the worm shaft, from which the rotary feed of the circular table is derived. Only one of these feeds can be engaged at any one time. All three feeds can be reversed. The circular table is graduated round its edge in

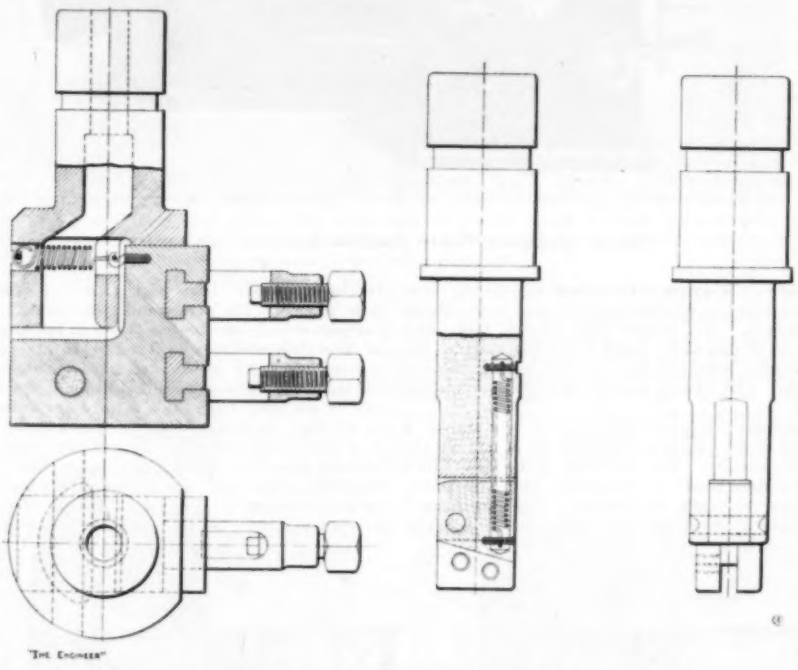

FIG. 23—CLAPPER BOXES FOR SLOTTING MACHINE—ATKINS

degrees, and, in addition, carries a division plate with twelve equally spaced slots, with which a latch at the front of the table support can be engaged. The circular table is designed to permit machining to be done with a flood of a cutting fluid. This fluid and the cuttings pass down through the centre of the table, and outwards into a trough at the side of the machine. All the screws of the table motion are fully protected from the cuttings. The worm rotating the circular table can, by the movement of a lever, be disengaged from the worm wheel, so that the table may be turned by hand quickly for setting purposes. The belt striking gear can be operated from a rod passing to the front of the machine, and a foot brake is provided to enable the ram to be stopped at the top of its stroke. The machine has a stroke of 6in., and on its 16in. diameter circular table can accommodate work up to 24in. in diameter and 9in. in height. The longitudinal feed motion is 10in., and the transverse motion 8in. Each of the three feed motions can be effected at four different rates in either direction. The head swivels 10 deg. on either side of the vertical. The machine takes about 2 horse-power to drive it.

H. W. WARD AND CO., LTD.

One of the largest combination turret lathes is that shown on the stand of H. W. Ward and Co., Ltd., Dale-road, Selly Oak, Birmingham, which is illustrated by Fig. 25 It has a single pulley all-geared headstock which is driven directly from the main shaft. The pulley runs on ball bearings mounted upon a stationary shaft, rigidly secured to the headstock, so that no belt pull is taken on the driving shaft. The driving clutch consists essentially of two metal cones, internal and external respectively, held in engagement when driving by a compression spring. The clutch as a whole is designed with an ample margin of power and takes up its load sweetly and without shock. The cones are self-adjusting. Sixteen spindle speeds are provided in the forward direction and eight in the reverse direction. These speeds are clearly shown on an indicator plate placed directly under the five selecting levers which are conveniently situated for the operator. These levers engage, at their further extremity, with a slotted plate which prevents accidental movement. Each lever is directly connected to the driving clutch as well as to its particular sliding gear. In making a speed change the lever is first depressed, thus disengaging the clutch, and then moved horizontally to slide the gear. This horizontal movement cannot be made without first depressing the lever, so that no gear can be moved with the clutch in action. Conflicting gears cannot as a consequence be engaged. The final driving gear is the on y one attached to the spindle. It is placed at the end of the spindle adjacent to the front bearing, which is, of course, the best position to minimise torsional strains. The whole of the mechanism is enclosed in a dust-proof casing, but covers are so arranged that any portion of the headstock can be examined without disturbing the bearings or the gears. All the gears run in oil and a sight dial is provided to show the level.

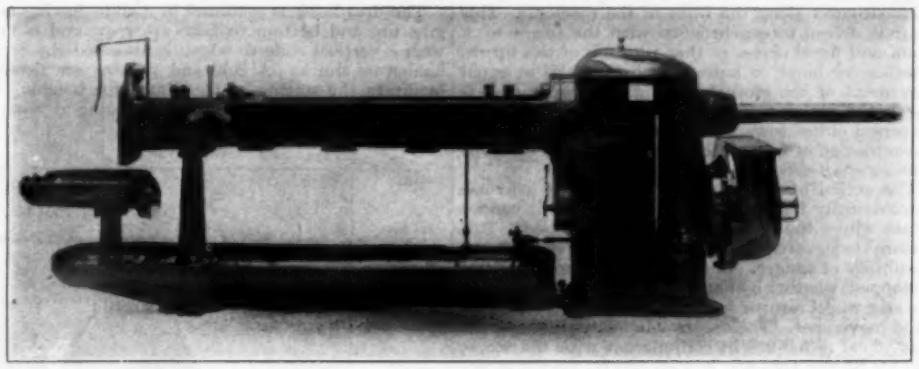

FIG. 24—BROACHING MACHINE—WARD

The spindle is ground on its external diameters and runs in parallel capped gun-metal bearings of exceptional length. There is a 8½in. clear hole throughout its length.

The saddle has automatic sliding and surfacing motions, actuated by one lever, so that it is impossible to get both into action at the same time. These motions are controlled from a gear-box, which is driven by a train of gears from the headstock. The gear-box is situated immediately beneath the front of the headstock and provides ten rates of feed to both sliding and surfacing motions. The feeds are obtained by two levers, both conveniently situated and indicated to assist in the rapid selection of the required feed. The direction of the automatic feeds to the saddle is reversible by the single movement of one lever, so that the saddle and cross slide can be traversed either towards or away from the chuck as required. The cross slide carries a square turret in the front and a tool post at the rear. The square turret is of forged steel and is arranged to index in four different positions by means of a spring-loaded index plunger and hardened steel bushes. Six stops are provided for the sliding motion and four for the surfacing motion, and these are arranged so that they will automatically trip out the feed when the saddle or cross slide has reached the required position.

The chasing motion applied to the saddle is obtained by means of a detachable leader screw and nut, the leader being driven from the gear-box, which allows the rotation to be altered as required in the ratio of 1 to 1, 2 to 1, or 4 to 1, with the spindle. By these means it is possible to cut three different pitches with each leader. Another feature of the chasing saddle is the quick withdraw motion connecting the cross slide to the leader nut so that both operate simultaneously. By this combination the tool is advanced to the cut by the same motion as the engagement of the nut with the leader, and on withdrawal both tool and nut are moved to their inoperative positions by the one movement of the lever.

The six-sided turret and slide can be operated either by hand, through a star wheel and rack and pinion, or automatically by a separate feed shaft driven from the gear-box. By the use of the separate feed shaft the feeds to the turret are entirely independent of other motions, and the turret can be traversed along the bed at any feed, irrespective of movements being carried out on the other saddle. The turret can be rotated either by hand or automatically. The automatic rotation is derived from a constant-speed shaft running along the rear of the bed, through a friction clutch, which can be adjusted to suit the weight of

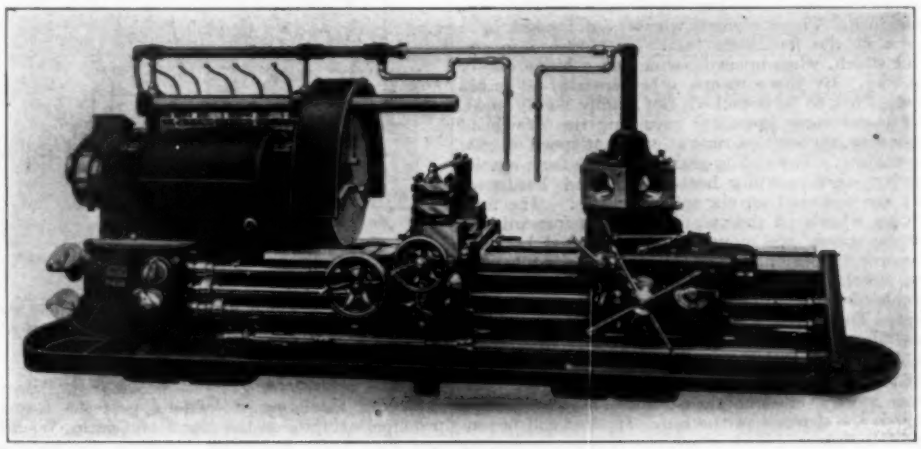

FIG. 25—LARGE COMBINATION TURRET LATHE—WARD

varying tool equipments. It is quite safe in operation and can be arrested by hand pressure on long tool holders. The turret can be rigidly locked by means of a convenient lever which actuates an excentric between the halves of a split ring of a diameter approximating the size of the hexagon across the flats. The stops for the turret slide are carried upon a hexagonal shaft situated along the front of the machine. This shaft is driven in synchronism with the turret by a chain and bevel drive, so that rotation of the turret, whether by hand or automatically, results in equal movement of the stop shaft, and the proper stop is positioned without fail. The saddle can be rapidly traversed either towards or away from the chuck by the actuation of a clutch connected with the constant running shaft mentioned above.

The action of engaging the quick power traverse automatically frees the star wheel, so that it cannot rotate whilst the saddle moves along the bed. This feature safeguards the operator and prevents all possibility of danger. Immediately the rapid traverse is stopped, whether by hand or against the safety stop, the star wheel returns to engagement and is ready for hand movement. The accurate indicator fitted to the star wheel is for use in conjunction with the stops, and by its use accurate lengths can be readily maintained. Fifteen rates of feed are obtainable on the turret saddle. Five of these are controlled from the gear-box at the left-hand end of the machine, whilst the apron contains an auxiliary gear-box giving three additional changes. The feeds are engaged by a single lever on the turret apron and can be tripped out by hand. Safety devices are fitted wherever necessary for protection of the operator and the mechanism. All gears are guarded against the entry of dirt and chips. Slipping clutches are fitted on both feed shafts, and safety stops are provided to prevent the saddles fouling each other.

The leading dimensions of this machine are:—Height of centres, 15in.; swing over the bed, 32in.; swing over the cross slide, 21in.; length of automatic feeds (both slide and turret), 54in.; maximum distance from mandrel nose to turret, 72in.; size of hole through mandrel, 8¼in. It requires 20 horse-power.

The broaching machine—shown in Fig. 24—is the outcome of some extensive experiments specially carried out with the object of obtaining reliable data respecting correct cutting speeds and the proportions of broaches. These experiments showed that, according to the material, the proportion of diameter or periphery to depth of hole to be broached, and the conformation of the hole, a wide variation in cutting speeds is required, if the best results are to be obtained. The makers have, therefore, provided four rates of cutting speed in this machine, two of which are controlled by a lever, and two by change wheels, while additional speeds can be provided by means of further change wheels, if required.

As will be seen from the engraving the headstock and base are cast in one piece. The single pulley all-gear headstock is driven direct from the main shaft. The pulley runs on ball bearings mounted upon a bracket bolted to the headstock, so that the driving shaft is relieved entirely of belt pull. The driving clutch consists essentially of two metal cones, and is similar to that fitted on the lathe just described. Four spindle speeds are provided giving four rates to the drawhead in a forward direction. These rates are clearly indicated on the plate which is affixed to the headstock near the gear shifting lever. The lever is directly connected to the driving clutch as well as to the sliding gear.

In making a speed change, the lever is first pulled outwards towards the operator. This withdraws the lever from the notched plate, and at the same time disengages the clutch. The change can then be made by moving the lever to the right or left according to its position. Afterwards two changes of speed are obtained through change wheels, which connect the pulley shaft to the first intermediate shaft in the headstock. These change wheels are housed in a recess in the headstock, and are covered up by a lid which, when opened, swings on a hinge out of the way. By these means other speeds best suited to the work to be broached, can readily be obtained. The fast reverse speed for returning the drawhead to its starting position runs at constant speed of 28ft. per minute. The sliding gears are made from special quality steel carefully heat-treated and hardened, and are mounted on six splined shafts. The final driving wheels on the spindle for both forward and reverse speeds are mounted on gun-metal bearings of ample dimensions. The forward drive is taken by dog clutches, the teeth of which are made of tool steel hardened. These are renewable in case of undue wear. The reverse drive for the return stroke is through a friction clutch, which ensures the stroke being taken up without shock.

The draw screw has a four start thread which provides a very efficient thrust angle, and minimises frictional resistance in the nut. Its free end is protected by a steel guard, which also acts as a container for the lubricating oil. Above the nut and spindle at the top of the headstock a trough is formed in the casting. A force pump situated at the base of the casting, and driven directly from the pulley shaft, keeps a continuous stream of oil pouring into the trough, whence it is led by tubes to the bearings and to the draw screw nut. As long as the machine is at work, therefore, the moving parts are kept thoroughly oiled. A sight dial is provided to ensure that a proper level of oil is maintained. The nut for the draw screw is housed at the front or inner end of the headstock, and is readliy accessible. The main ball thrust bearing is arranged at the front end of the headstock adjacent to the nut, which arrangement effects a considerable saving of floor space.

The drawhead is mounted in a slide having taper gibs top and bottom to take up wear, and is fitted with a vertical slide to which is attached the broach holder or chuck. A rule and pointer are fitted to facilitate the setting of the chuck for height. The quick acting chuck permits the changing of broaches very rapidly. It grips the broach by sliding jaws closing down on to a shallow neck formed in the shank of the broach. To release the broach the outer knurled cap is moved by hand along the body of the chuck, thereby allowing the jaws to spring clear of the broach. The reverse action takes place on closing the chuck.

The automatic stop at each end of the stroke is effected by dogs which are carried on a rod at the rear of the machine. The outer end of the arm (which carries the drawhead) is machined, and has a 5in. hole passing through the centre. This provides a ready means of attaching the work bushes and any special fixtures which may be required. The stroke of the machine is 50in., and it will broach out a 3in. square hole from the round in mild steel.

CHARLES WICKSTEED AND CO., LTD.

Sawing machines of various patterns form the principal exhibits on the stand of Charles Wicksteed and Co., Ltd., Kettering. Among the hack saws shown there is one specially designed for use in conjunction with high-speed saw blades. This machine is fitted with ball bearings, and is otherwise adapted for working at a fast speed. It runs at 160 revolutions per minute, a speed which, in the makers' experience, cannot be exceeded with any advantage.

The inserted tooth circular sawing machine illustrated in Figs. 26 and 28 is also exhibited by Messrs. Wicksteed. It is designed to deal with square or round bars up to 6in., and with joists up to 12in. by 6in. It is fitted with an inserted tooth circular saw, 22in. in diameter by ¼in. thick. Tests, we are informed, have shown that the machine can cut through the maximum sizes of bars or joists for which it is designed in 1½ min. The drive can either be by belt or through raw hide pinion and gear wheel from a 6 H.P. electric motor. The power is transmitted through a change-speed gear-box, giving cutting speeds of 52ft., 80ft. and 115ft. per minute. The change wheels are of phosphor bronze or of case-hardened wrought iron. The final transmission to the saw spindle is made through a worm drive and a pair of double helical gear wheels. The saw spindle is carried on a sliding carriage which can be fed forward towards the work at nine different speeds, ranging from ⅛in. to 4½in. per minute. An automatic trip motion is provided for the feed. The work is held in a screw vice, which can be set with the work at any angle from 90 deg. to 45 deg. In addition to the screw-down jaw, there is a vee-block, operated by a horizontal screw, for holding round or square bars up to 6in. The roller supporting the work on the near side of the vice can be rotated through a chain drive. One of the features of the machine is the ease with which the saw can be removed without disturbing any other part.

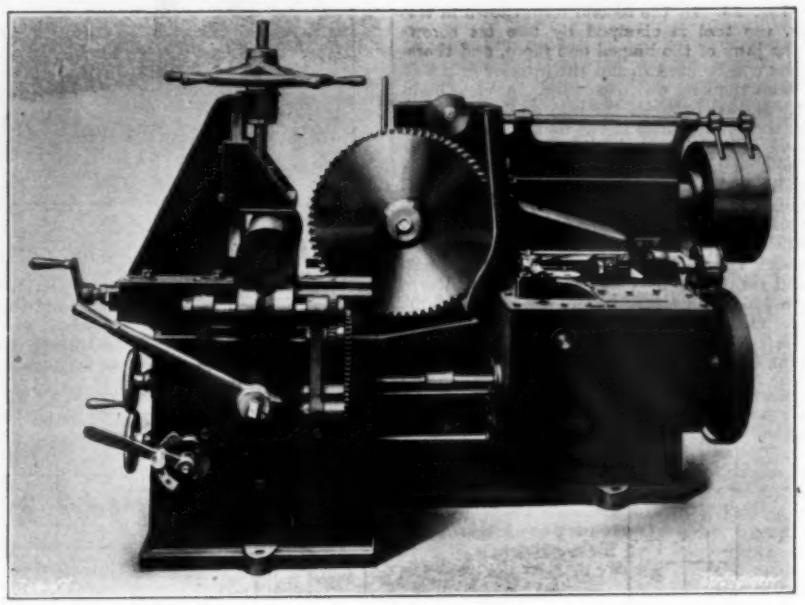

FIG. 26—INSERTED TOOTH SAWING MACHINE—WICKSTEED

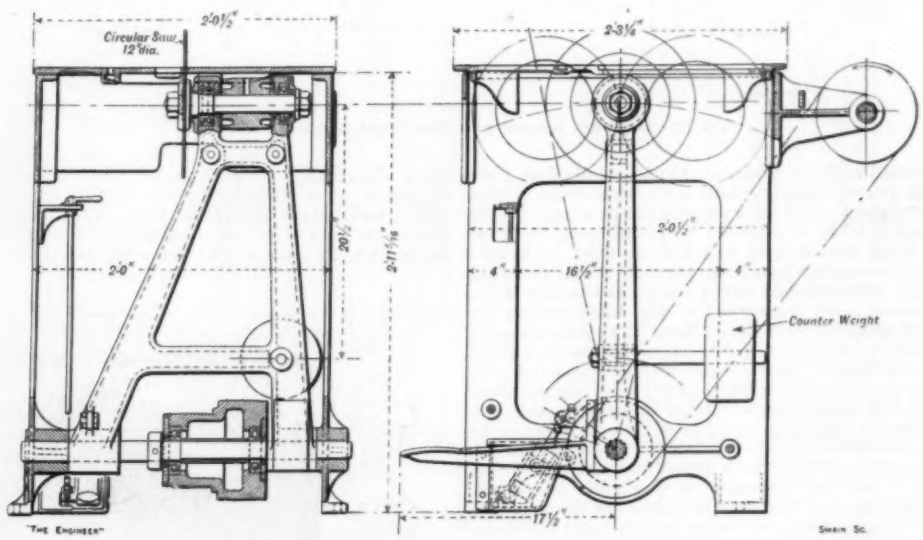

FIG. 27—PENDULUM SAW FOR LIGHT SECTIONS—WICKSTEED

An interesting pendulum saw, of which we reproduce a drawing in Fig. 27, is also to be found on Messrs. Wicksteed's main stand. This machine has been designed to cut rapidly light sections, such as channels and angles and thin strips of brass, copper, &c. The saw, 12in. in diameter, is mounted on ball bearings at the top end of an A frame, which is journaled at the foot on a shaft extending across the base of the machine. This shaft carries, on ball bearings, a two-stepped belt pulley. Over one step a belt passes to a countershaft at the back of the machine. Over the other step a belt is taken to the pulley on the saw spindle. The frame is counterbalanced, and can be swung forward by the operator through the agency of a foot lever. A hand move-

ment can also be provided for the frame. An oil dash-pot is linked to the swinging frame with the object of securing a uniform movement of the saw under varying pressures on the foot lever. The resistance provided by the dash-pot can be regulated by con-

to supply coolant to the grinding wheel of this machine is driven by a 20 horse-power motor, and the whole machine weighs 35 tons.

On the same stand there is also a vertical grinding machine with a segmental wheel 18in. in diameter,

the cams. The spindle driving shaft drives the four spindles through change gears and clutches which are arranged to declutch in the loading position. Any speed from 25 to 100 r.p.m. can be obtained by altering the two gears only. The driving shaft for the

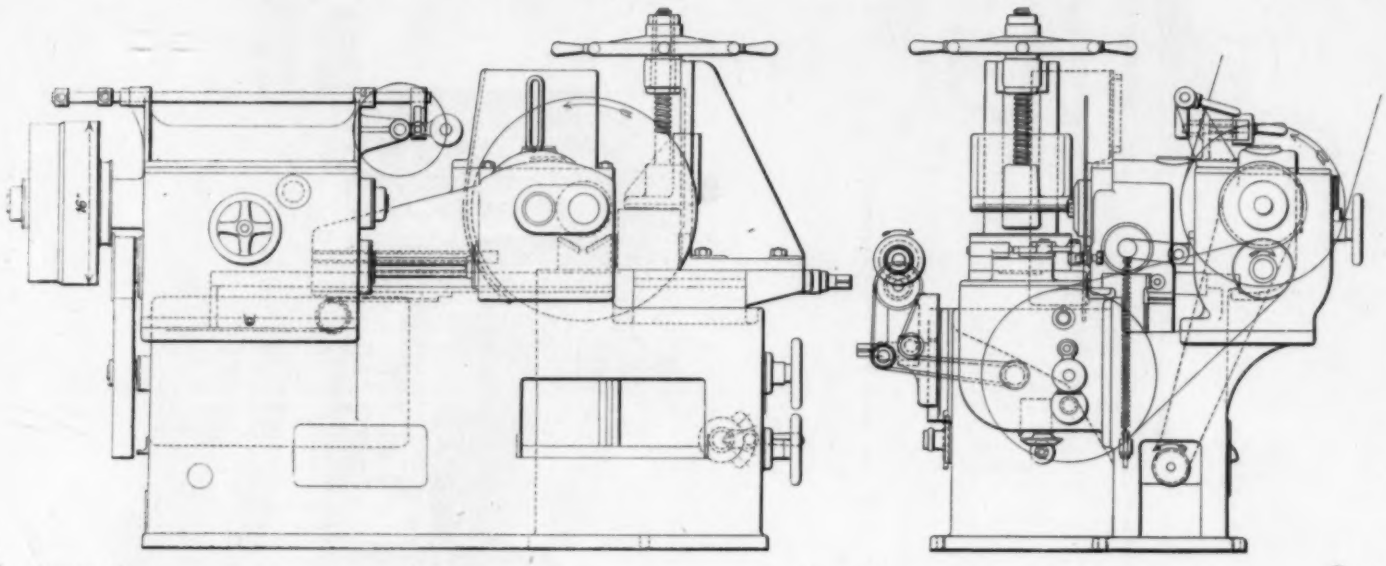

FIG. 28—GENERAL ARRANGEMENT OF HIGH-SPEED SAWING MACHINE—WICKSTEED

trolling the size of the orifice, through which, on the cutting stroke, the oil is forced out of the dash-pot into the surrounding reservoir.

JOHN LUND.

Among the grinding machines exhibited, one of those on the stand of John Lund, Crosshills, near Keighley, is claimed to be the largest of its kind in the British Isles. It is of the vertical spindle type, for grinding flat surfaces, and is illustrated in Fig.

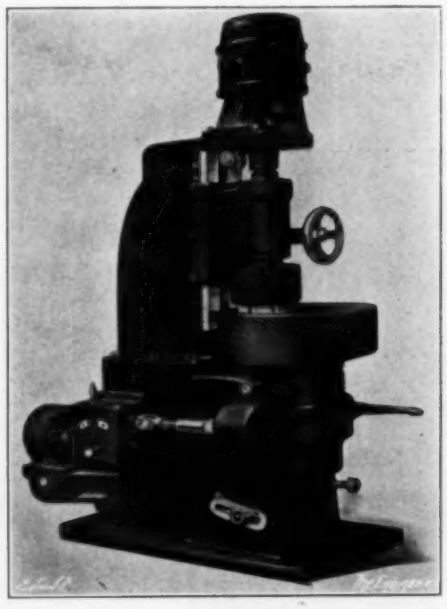

FIG. 29—GRINDING MACHINE—LUND

35. The grinding wheel itself is 25in. in diameter, is of the segmental type, and is driven by a 40 horse-power motor. The wheel and motor are mounted on a slide, much after the fashion of a planing machine, so that they can be traversed across the work, which is clamped on to a table 7ft. wide by 14ft. long. The maximum height of work which can be accommodated is 30in. The cross traverse of the wheel and the travel of the table are each operated by an electric motor of 7½ horse-power, and as these two movements are independent the machine is very convenient for grinding surfaces on which bosses or other such obstructions prevent a plain straight run.

One of the outstanding features about the Lund grinding machines is the arrangement adopted for supporting the wheel spindle. It is mounted in roller bearings with double ball washers to take the thrust. These two washers definitely fix the position of the spindle vertically; but, as an added security against the wheel dropping as it leaves the end of a cut, and thus producing a sloping face, the whole weight on the spindle is overbalanced by a counterweight, so that the load always comes on the upper ball washer. There is a separate system of counterweighting for the slide carrying the wheel spindle. The pump used

and a table 4ft. long by 16in. wide, which will admit work up to a height of 18in. The spindle arrangement is similar to that just described, and it is driven by a 20 horse-power motor. The travel of the table is effected by a separate 1 horse-power motor. A third machine—see Fig. 29—has a segmental wheel 8in. in diameter and a rotary table of 18in. diameter. It is driven by a 7½ horse-power motor, and weighs about 30 cwt.

COLCHESTER LATHE COMPANY.

The most novel machine on the stand of the Colchester Lathe Company, Hythe, Colchester, is the vertical spindle lathe—illustrated by Figs. 30 and 31—which is shown turning and boring stepped cone pulleys, about 8in. in diameter by 2½in. face on each of the three steps. These pulleys are produced at the rate of one piece in six minutes. It will be seen that the machine has four spindles, which are moved round,

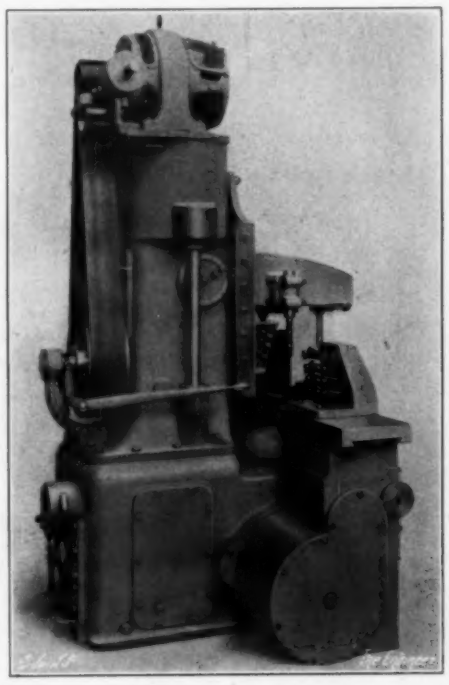

FIG. 30—VERTICAL LATHE—COLCHESTER

in turn, from the loading station to the machining positions. All the operations, except that of putting the blank in the chuck at the loading station, are entirely automatic.

The machine consists of a main slide which rises and falls, and two slides which move forward and back. These three slides carry all the cutting tools. The cams are permanent, and do not have to be changed. The spindle speeds and feeds are changed as easily as they are in any ordinary engine lathe. The main shaft is driven through a friction clutch, and drives by chains the shafts for the spindles and

spindles carries a clutch which allows all the spindles to be stopped and also a clutch which engages the table indexing mechanism. The vertical slide from which all boring and turning in an axial direction is done is driven by a fixed set of cams on the top cam drum. It is balanced and has a vertical travel of 7in. and a cutting travel of 6in. The side slides which do all the cutting in a radial direction are driven from the two side drums by rocking levers. They have a travel of 6in. and a cutting travel of 4½in. The

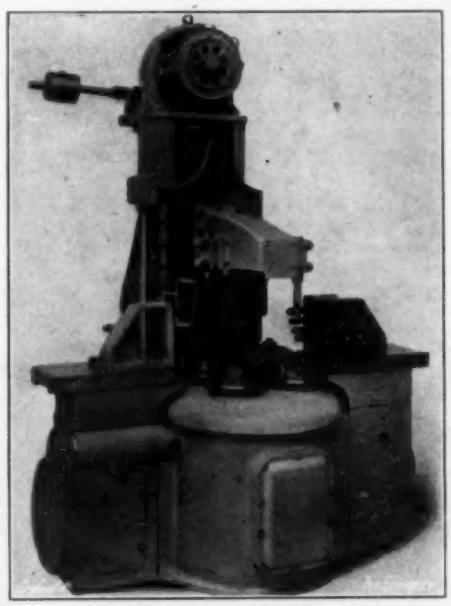

FIG. 31—VERTICAL LATHE—COLCHESTER

driving shaft for the cams has a double clutch, which can either engage the fast constant speed drive from the main driving shaft or the slow speed to give the cutting feed. The rate of cutting feed is variable from 24 to 120 per inch, and as it is taken from the spindle drive it is constant whatever the r.p.m. of the spindle. It can be varied by altering two gears.

The sequence of movements from the finish of one cut to the finish of the next is:—When the tools simultaneously reach the end of the cut, the spindles are stopped, the cam drive is altered from the slow feed to the fast feed, and the slides are run back. When the slides are fully withdrawn, the indexing plunger is withdrawn, the indexing clutch is engaged, and the cam feed stopped. The spindles and cam drums are therefore stopped while the table indexes. When the table is indexed the cam drums and the spindles are started up, the fast speed is used to run up to the work, and then the slow rate of feed is engaged for the cut. This point is altered to suit different sizes of work by altering the clutch knock-over cam on the side drum. The largest diameter of work the machine will take is 9in., and the longest length from the chuck face to the boring arm at the finish of the

SOME MACHINES AT THE MACHINE TOOL EXHIBITION, OLYMPIA

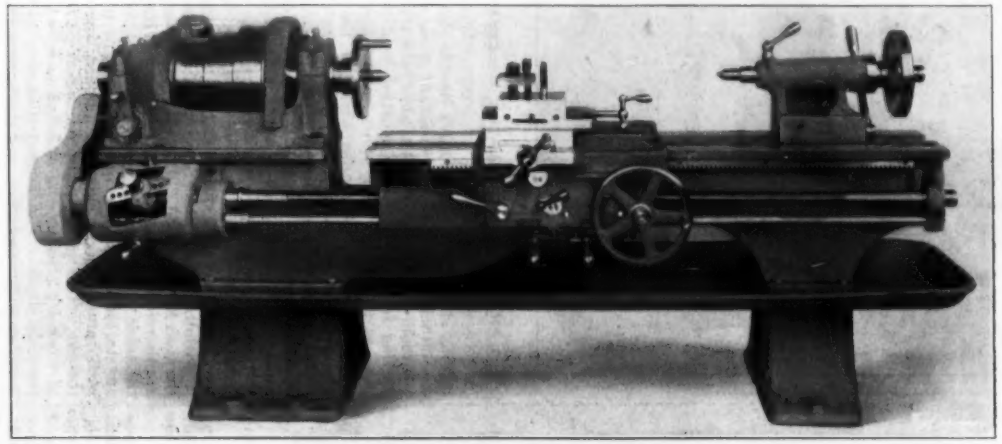

FIG. 32—7½IN. HIGH-SPEED LATHE—COLCHESTER

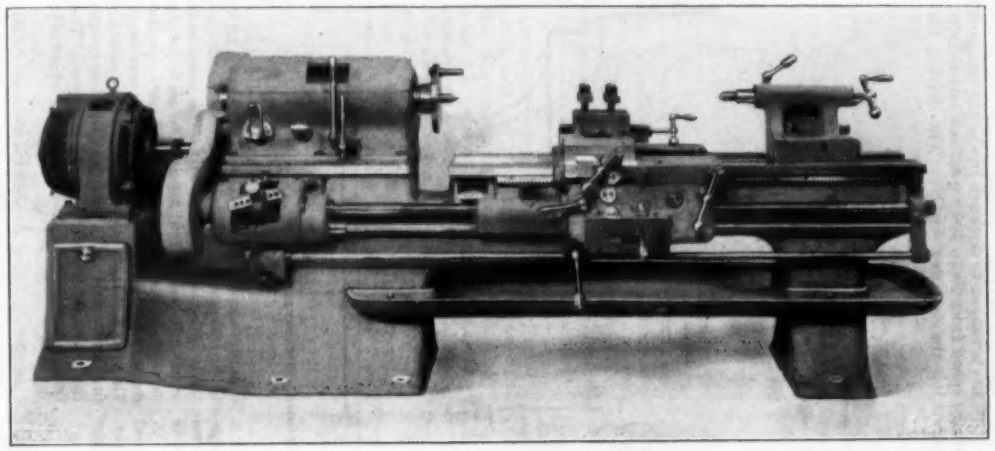

FIG. 33—8½IN. ALL-GEARED LATHE—COLCHESTER

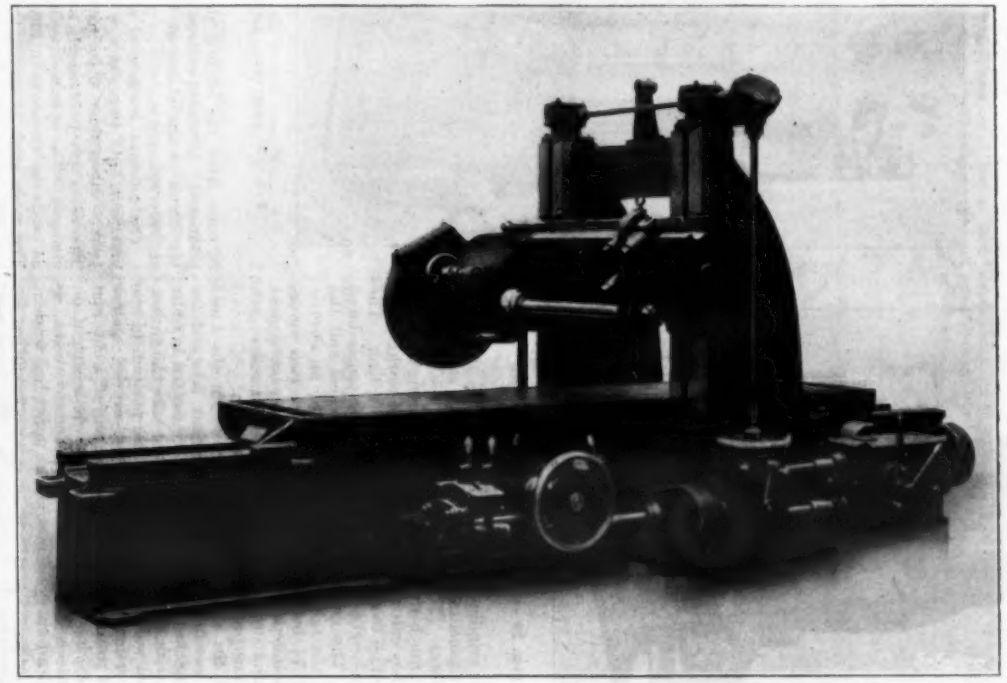

FIG. 34—PLANO-MILLING MACHINE—KENDALL AND GENT

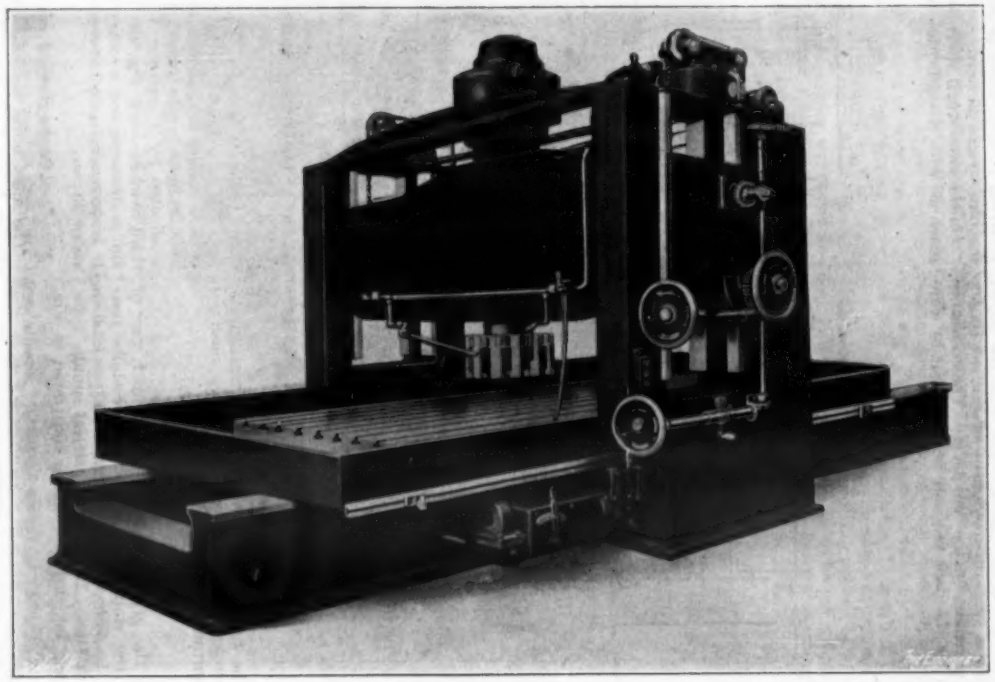

FIG. 35—FLAT SURFACE GRINDING MACHINE—LUND

cut is 9in. When putting work through in batches of 100 the maker's inform us that they have found the average saving of time over turret lathe work to be about 75 per cent., while the set up is so simple that with a run of 25 only they generally save about 50 per cent. on time.

Two other new machines exhibited by this firm are the two lathes represented by Figs. 32 and 33. Of these that shown by Fig. 32 is noteworthy on account of the fact that the bed and the slides are ground after machining. It has centres 7½in. high, and has a very powerful headstock which is capable of using high speed steel to its full advantage. The

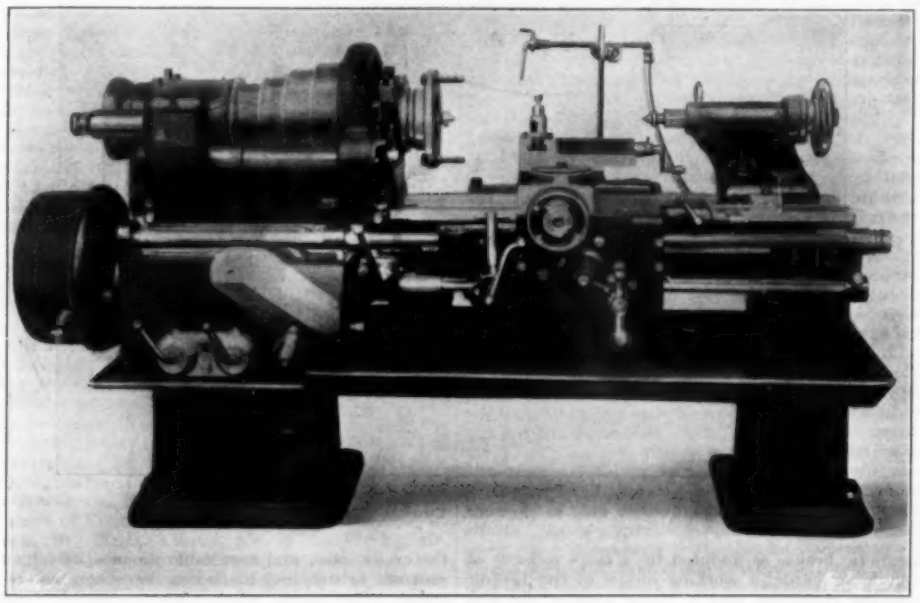

FIG. 36—TOOL ROOM LATHE—J. LANG

cone and gear are so graded that a uniform range of speeds can be obtained. The hollow spindle, which is ground, is bored to admit a 2in. diameter rough bar, and runs in parallel bearings of phosphor bronze. It is fitted with a ball thrust. All the gearing is machine cut and guarded; all pinions and reversing wheels are made of forged steel and machine cut from the solid. A bevel reverse is fitted which can be operated whilst the machine is running. The loose head has a large base and is gripped to the bed by an excentric and handle. It has a ground spindle, and is adjustable for taper turning. The slide rest is indexed and can be swivelled to any angle. The screw is always covered, and there are no recesses to harbour dirt or chips. The saddle is very heavy, with a long narrow guide and ample bearing surface. It is of sufficient length in front of the bed to enable the largest diameter of work to be faced with one setting of the tool. The rack and pinion are of steel, and the self-acting sliding and surfacing motions are put in and out of gear by means of drop worms situated in the apron. The lead screw is ¼in. pitch. and is fitted with a phosphor bronze clasp nut. The quick change gear-box gives thirty-two different pitches for screw-cutting, ranging from 4 to 60 per inch, and thirty-two feeds ranging from 8 to 120 per inch. The self-acting feeds are positive, and all three are interlocked, so that only one can be in operation at one time. The leading dimensions of the machine are:—Bed, 12½in. wide, 9in. deep, 7ft. long; admits between centres, 3ft. 2in.; headstock cone, 12½in. to 9½in. by 3½in. wide; hole through spindle, 2 1/16in. diameter; countershaft speeds, 100 and 240 r.p.m.; front headstock bearing, 3⅞in. by 4½in.; swings over bed, 15in. diameter; swings over saddle, 10½in. diameter; admits in gap, 26in. diameter by 7in. wide in front of faceplate; approximate weight, 27 cwt. (7ft. bed).

The lathe shown in Fig. 33 is, it will be seen, of the enclosed headstock, all-geared type, and is driven by its own electric motor. It is of 8½in. centres, and will admit work up to 4ft. long. The gear-box is so arranged that eight speeds in geometric progression can be obtained, while there is a reversing mechanism which can be operated without stopping the drive. The gear-box gives thirty-two different speeds, which can be used for screw cutting, or as ordinary feeds. For screw cutting the range goes from 4 to 60 threads per inch, and for feeds from 16 to 240 per inch. Special care has been taken in the design of this machine to interlock the various movements in such a manner as to make it practically "fool-proof." Besides those machines which we have described there are, on this stand, a number of other lathes, ranging from 5in. up to 9½in. in centre height.

JOHN LANG AND SONS, LTD.

There are half a dozen lathes of various sizes and a machine for rounding the ends of gear wheel teeth on the stand of John Lang and Sons, Ltd., Johnstone, while the firm has two other lathes on the stands of steelmakers in the hall. The lathes are of several different sizes and type, and one of the most interesting is that illustrated in Fig. 36, which has been specially designed for toolroom work. It is of 8½in. centres, and will admit work 2ft. long between the centres. The headstock, which, as will be seen, has the gearing at the front, has large and small gear reductions, and to ensure a high belt velocity at all spindle speeds, the steps of the cone are large in diameter. With a two-speed counter motion twelve spindle speeds in each direction are obtained:—Four through the cone direct, four through the small, and four through the large gear reductions. The hollow spindle runs in parallel gun-metal bearings of large diameter. The bed is of the maker's narrow guide type, but is unusually wide so as to give the rigidity necessary for accurate work. The bed can be made with a gap if desired. The saddle has a longitudinal guide about eight times greater than its width. With this arrangement there is naturally much less tendency for the saddle to twist when moving along the bed. The compound slide rest has a swivel arrangement for conical turning with a machine-divided index. There are adjustable taper wedges on all slides to take up wear, and large micrometer dials on the saddle and swivel slide screws reading to 0·001in.

The centralised control apron provided for the engagement and disengagement of the self-acting sliding and surfacing motions by means of separate drop-out worms controlled by one handle, is novel in design, and has the following features:—(1) Instantaneous engagement or disengagement of feed motions; (2) it is impossible to screw-cut while the sliding or surfacing feeds are in action; (3) it is impossible to engage the sliding or surfacing feeds while screw-cutting; (4) it is impossible to put the sliding and surfacing feeds into action at one time; (5) it is compact in design to allow the operator to get close to the lathe for inspecting his work, and still be within reach of all the control handles; (6) an indicator dial is fitted to facilitate the engagement of the nut and leading screw when screwing threads.

The Lang universal gear-box is a further development of the usual magazine type of box, as it provides for the cutting of metric pitches and inch pitches such as may be required for worms. This gear-box, without the use of any loose change-wheels, will cut:—(1) Threads per inch; (2) metric pitch threads; (3) threads for circular pitch worms. The gears are all made of nickel chrome steel, oil tempered where necessary—and run in an oil bath in the main casting. The enclosed front, uncommon in this type of gear-box, eliminates the danger of foreign matter entering the box. A swing frame is provided at the end of the box, so that very special threads can be cut by the provision of suitable change wheels. Some forty different threads can be cut by the manipulation of the levers alone. A reverse motion lever enables the direction of the sliding, surfacing, and screw-cutting motions to be changed, and one automatic knock-off stop to the sliding and screw-cutting motions in each direction is provided. The lead screw is used exclusively for screw-cutting, so that it is not damaged by ordinary cutting. It is made of high quality steel, and the error in pitch is guaranteed to be correct within plus or minus 0·001in. in any 6in., or plus or minus 0·003in. in the total length.

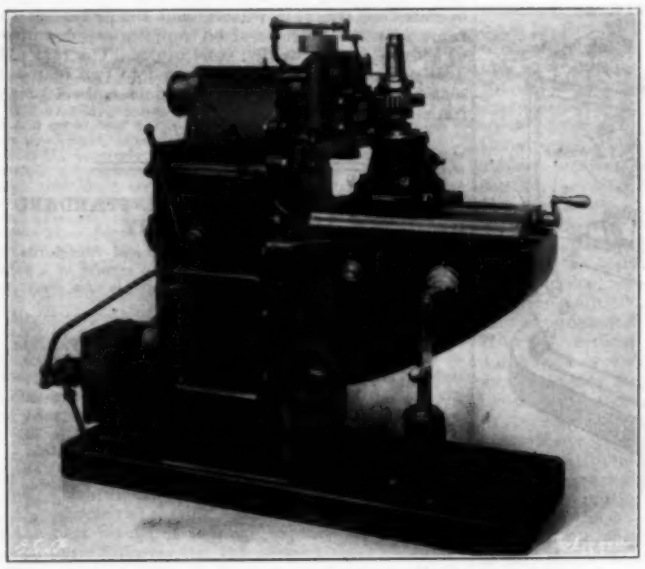

FIG. 37—GEAR TOOTH ROUNDING MACHINE—LANG

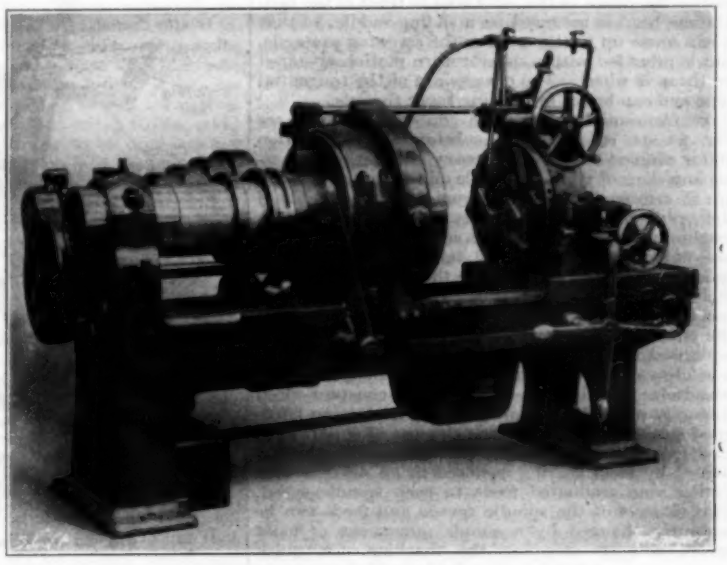

FIG. 38—PIPE SCREWING MACHINE—KENDALL AND GENT

The leading dimensions of this machine are as follows:—Length of bed, 6ft.; admits between centres 2ft.; width of bed on face, 12in.; width of bed on body, 9½in.; depth of bed, 8in.; swings clear of bed, 13in.; swings clear of saddle, 9in.; diameter of hole in spindle, 2½in.; front spindle bearing, 4½in. diameter by 4½in. long; back spindle bearing, 3½in. diameter by 3½in. long; small gear ratio, 3·3 to 1; large gear ratio, 10 to 1; cuts threads per inch, 1½ to 80; cuts metric threads, 0·19 to 10 mm.; cuts pitches per inch, 0·037 to ½in. pitch; feeds, 4½ to 240 cuts per inch; H.P. required (maximum), 4 H.P.

The machine shown in Fig. 37 is intended for rounding off the ends of the teeth of gear wheels, such as those of change-speed gear-boxes, which are slid

into mesh endways. The operation is a milling process, with a conical shaped cutter, which is made to travel round the end of the tooth and give it a semicircular form. The work, it will be seen, is mounted on a vertical spindle on a table which can be adjusted to suit the size of the job in hand. Facing it there is the headstock carrying the milling cutter. The spindle is really three spindles, placed one within the other. The outer spindle, which has a "U" shaped slot running its entire length, is mounted in ample bearings in each end of the headstock. This spindle is controlled by a cam and rack motion which imparts a forward and reverse rotary movement to it. The middle spindle, which fits in the "U" shaped slot of the outer spindle, can be adjusted vertically to give the required variation of throw for different pitches. It is indexed at each end to ensure an accurate and parallel adjustment. The inner spindle, which carries the rounding cutter, runs on ball bearings inside the middle spindle. It is arranged with a draw back collet for holding the cutter, and has end adjustment for convenience in setting the cutter.

On the front end of the headstock there is a bracket which is arranged with a dividing mechanism of new design. A special cam controlling the device is fixed to the front end of the outer spindle and operates through a lever mechanism to a dividing bar which gives a positive action to the gear. This mechanism has an index for convenience in making accurate adjustments for various pitches. The dividing bar carries a rack in which the particular tooth of the gear being rounded is held positively during the cutting operation. This dividing mechanism once set for a given pitch will round the teeth of gears of any diameter within the capacity of the machine without further adjustment. The only alteration to the setting of the machine for gears of the same pitch but of different diameters is a movement of the work carrier slide. On the front of the column there is mounted a knee slide which is adjustable vertically to suit various widths of gears. A slide with a reciprocating motion for withdrawing the work from the dividing rack is fitted on this knee slide and is operated by a cam placed inside the column. This cam arrangement is synchronised with the cam and rack motion to the outer spindle, so that dividing takes place during the return movement of the spindle. These machines are capable of rounding the teeth of gear wheels up to 26in. in diameter.

KENDALL AND GENT (1920), LTD.

There is a new machine on the stand of Kendall and Gent (1920), Ltd., Manchester, in the form of the screwing machine shown in Fig. 38. It is intended for screw-threading pipes up to 6in. in bore, and is peculiar in that the work revolves instead of the dies. It will be seen that the headstock has an unusually large hollow spindle, and through this the pipe to be screwed is threaded. It is gripped and driven by a chuck which can be operated while the machine is in motion by means of the lever seen in front of the bed. The die head is mounted on a sliding saddle, so that it can move up to the work as the screwing proceeds, and is provided with a quick-return motion operated by the star wheel. The chasers are of the tangential type and can be set for cutting taper threads.

A plano-milling machine on this stand—see Fig. 34—is of unusually substantial construction and is claimed to take very heavy cuts without showing any signs of vibration, while all the control handles are so arranged as to be convenient to the hands of the operator. The machine is specially suitable for machining such pieces as the connecting or coupling rods of locomotives. The bed, table and uprights have broad surface flat slides, while the cross slide has an inclined face which carries the spindle housing, together with an adjustable bearing for supporting the mandrel. The spindle is of high-carbon steel and is carried in a steel sleeve which is provided with a fine adjustment for putting on the cut or adjusting the mandrel. The drive is effected by a constant-speed motor connected to an all gear-box containing hardened steel gearing giving nine changes of speed. The feed motion to the table is reversible and positively driven by steel gearing enclosed in an oil-tight box giving nine graduated feeds to each spindle speed. The changes of the spindle speeds and feeds can be instantly changed by a simple movement of hand levers without stopping the machine. A quick motion is also provided to assist in setting the work. The spindle is 4in. diameter. The capacity of the machine may be gauged from the following particulars:—10ft. table travel; width milled, 3ft.; height, 2¾ft. to centre of spindle; spindle speeds, 15 to 53 revolutions per minute; feeds, 1in. to 8in. per minute.

THE IGRANIC ELECTRIC COMPANY, LTD.

In accordance with its usual custom at machine, tool and general engineering exhibitions, the Igranic Electric Company. Ltd., is showing a collection of its well-known products, notably control gear for electric motors. A recent development in this connection is a small automatic starter for use with A.C. motors up to 5 H.P. It is fitted with a thermal overload device and roller contact mechanism, instead of the usual moving buck-type fingers. Two multiple clapper type starters are shown mounted on a frame. One is for D.C. motors, and the other for A.C. machines. In both cases the rate of acceleration of the motor is governed by an adjustable timing relay. Needless to say, the firm is showing one of its well known universal starting and regulating panels with a self-acting starter of the solenoid multiple finger type for accelerating the motor; a magnetic interlock circuit breaker or clapper switch which opens and closes the main circuit, a shunt field regulator, with an interlocking device, which prevents the motor starting with a weak field and a double pole hand-operated main switch, which completely isolates the motor and other switchgear from the mains. A battery charging panel suitable for charging the batteries of electric vehicles, a magnetic brake, as adopted by a large number of shipbuilding yards, a working model of the Igranic newspaper conveyor, and a lifting magnet are also exhibited.

R. A. LISTER AND CO., LTD.

Among the exhibits of Lister and Co., Ltd., of Dursley, are some fine examples of the firm's petrol-driven auto-trucks, which run at speeds varying from 4 to 8 miles per hour, and are said to work fully loaded at a cost of less than ¼d. per mile for fuel and oil. Although weighing only 8¼ cwt., and having an engine of only 4½ horse-power, a Lister truck can carry a load of 1 ton up a gradient of 1 in 14; whilst on the level, an extra load of 2 tons can be comfortably drawn

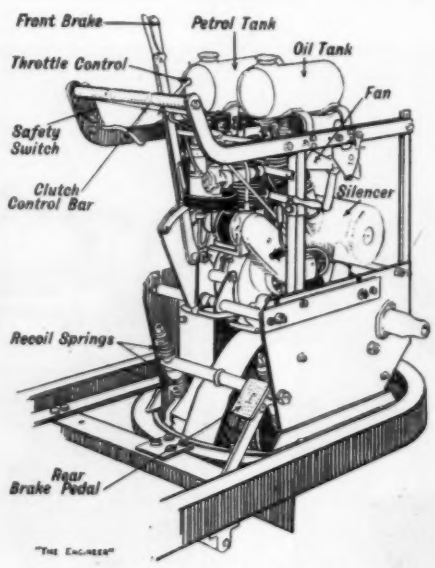

FIG. 40—POWER UNIT—LISTER

by means of trailers. The maximum load is naturally governed, to a large extent, by the road surface and the type of truck chosen. The control gear is extremely simple. The handle bar carries a single lever throttle control—as shown in Fig. 40, and beneath it is a pivoted bar controlling the clutch. As soon as the bar is released it makes contact with a safety switch, which short circuits the magneto, and so avoids accidents. The complete power unit—shown in Fig. 40—is mounted over the front driving wheel on a patented turntable, which allows the unit to be turned into any position or reversed entirely. Models of standard length can be turned within a radius of 6ft. 9½in. The power unit is a 600 cc. air-cooled engine provided with a fan. The power is transmitted through a heavy gauge chain to a friction clutch, the final transmission to the wheels being through a similar chain. Chain adjustments can be quickly made by means of excentric shafts.

The truck shown in Fig. 39 is the firm's standard platform model, type P.N. Where roads or floors have a good surface this type of truck has much to recommend it. The small rear wheels permit the use of a low-loading platform. The vehicle can also be manœuvred in and out of congested areas with great ease. The engine is a standard 600 cc. J A P machine, with a normal output of 4½ horse-power, and a plate is introduced between the cylinder and crank case in order to reduce the compression and to give smooth running. An exhaust valve lifter is fitted to ensure quick and easy starting. From a tank situated over the engine oil is supplied to an automatic pump on the crank case, and a variable amount of oil under pressure is supplied to the engine according to the speed. The clutch, which is very accessible, consists of an iron plate under spring pressure, making contact with a fibrous asbestos disc. The shaft runs on ball bearings and is operated by levers from the steering handle. It is possible to operate the clutch by either hand or by both hands, and if the lever is released while the clutch is operating, it makes contact with the safety switch and short-circuits the magneto. The clutch shaft and the rear member carrying the engine are mounted on excentrics in the frame, and by partly turning these excentrics the centre of the unit is altered, thereby tightening or loosening the respective chains. The front wheel is mounted in the centre of the steering ring on ball bearings, and is driven by a chain from the clutch shaft. Two expanding brakes are fitted, one of which is operated by foot; the other by a ratchet lever. The former operates on the rear wheels, and the latter on the front wheels. Petrol and oil supplies are contained in heavy ¼ gallon welded steel tanks. The rear axle does not rotate, but is firmly fixed to two rear axle seats, which are attached to side members of the frame.

(To be continued.)

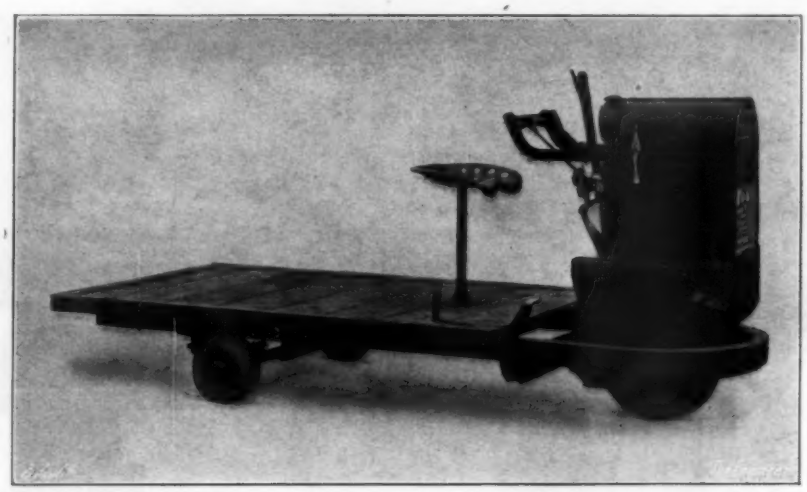

FIG. 39—PETROL-TRUCK—LISTER

A NEW BRITISH CHEMICAL STANDARD ALUMINIUM ALLOY.

WE are informed by British Chemical Standards, 3, Wilson-street, Middlesbrough, that the second of a series of non-ferrous standard analysed sample is now ready for issue. The analysis is as follows:—

Aluminium Alloy "A."

	Per cent.
Copper	4·68
Zinc	2·37
Nickel	1·85
Lead	1·51
Magnesium	1·34
Iron	0·51
Silicon	0·39
Manganese	trace
Tin	0·05
Aluminium	87·30
	100·00

This standard has been prepared in response to an appeal made at the last triennial meeting of co-operators in the movement and arising out of the growing use of aluminium alloys in the aero, motor and other industries. It will enable chemists to check their methods of analysis and individual working, and thus to settle disputes between buyers and sellers. The composition does not correspond to any one recognised specification, but is a compromise to enable it to be analysed concurrently with most of the B.E.S.A. alloys, such as L11, L8, L5, L24, also other alloys containing copper, zinc, nickel, magnesium, &c. As usual, the analyses have been undertaken by a number of chemists having special experience in this class of alloy, *e.g.*, referee analysts, manufacturers, users, and Government departments. The standard is available to anyone at a price based on covering the cost of preparing and issuing it. The three usual sizes of 50 g., 100 g., and 500 g. are provided, and a certificate (first edition) giving the names of the analysts collaborating and their analyses is furnished with each sample. In a later edition an outline of the methods employed will be included, and sent on request in exchange for the first edition.

The Institute of Metals.

No. II.*

ANNUAL MEETING AT LIVERPOOL.

ON Tuesday morning, September 5th, the members and visitors of the Institute of Metals assembled at the Adelphi Hotel, where the Lord Mayor, Miss Margaret Beavan, extended to them a very cordial and sincere welcome, which was suitably acknowledged by the President, Dr. Rosenhain.

The President then introduced to the members, and expressed a cordial welcome to, Professor Dr. W. M. Guertler, of the Verein Deutsche Ingenieure (German Society of Engineers), and Dr. W. J. P. Rohn, of the Deutsche Gesellschaft für Metallkunde (German Society for Metallography), at whose invitation the Institute is to hold its autumn meeting in Dusseldorf next year.

Professor Dr. Guertler, said engineers all over the world were building bridges of mutual understanding for the advancement of science and of technique in industry. The Institute of Metals and the Deutsche Gesellschaft für Metallkunde, he believed, were the only two societies of their kind in the world. The British Institute was at present about twice as old as the German Society, and he confessed that when the latter was created its adherents had already learned much from the work and records of the former. Nothing was more natural than that there should be a very intimate co-operation between the two bodies, and, therefore, the German societies would be very glad to welcome the members of the Institute next autumn.

The secretary then announced that the following members had been nominated for election to the posts indicated in 1929, and that the result of the forthcoming ballot would be announced at the annual general meeting of the Institute, to be held in London in March next :—President, Dr. W. Rosenhain, F.R.S.; Vice-presidents, Mr. T. Bolton, Sir Henry Fowler; members of Council, Mr. H. A. Ruck-Keene, Mr. J. Steven, Mr. W. G. Turner, Mr. H. B. Weeks, Mr. R. Lloyd Gibbins, Dr. H. Moore.

The technical meetings then opened with the presentation by Mr. R. May of the eighth report to the Corrosion Research Committee, of which we give the official *précis*.

CORROSION.

The Report deals with some further investigations of "impingement attack" which were undertaken in order to interpret the results of certain tests on condenser tubes, and, in particular, to explain the relationship which appeared to exist between the effects of intermittent cavitation in the water, and the effects of air bubble impingement.

Part I. deals with the behaviour of protective films under various conditions of impingement. A method of studying this behaviour by measurements of the "film potential" is described in detail. The method is particularly useful for comparing the healing powers of the natural protective films on different condenser tube alloys, and should be of assistance in the development of specially resistant condenser tubes.

Part II. describes some experimental work which shows that when there is no intermittent cavitation "impingement attack" can still take place as a result of air bubble impingement. This leads to the conclusion that there are two separate main causes of "impingement attack." In addition, the work shows that the size of the air bubbles entangled in the water is a more important controlling factor than was formerly surmised. Very small bubbles seem to be comparatively harmless, even under conditions of strong impingement.

The investigation has been greatly assisted by the use of the jet test apparatus, and this has developed into a form which is very convenient for preliminary tests on condenser tubes.

Part III. is largely a discussion of the more important factors controlling "impingement attack" in condensers. The view is taken that there are two main causes, namely, intermittent cavitation as shown by Sir Charles Parsons, and air bubble "impingement" as shown by Dr. Bengough, R. Pirret, and the author. In either case the mechanism of the action has points of great similarity, and both are known to depend to an important extent on the occurrence of rotating motions of the water.

Definite conclusions are reached regarding the prevention of "impingement attack."

Mr. Sterry B. Freeman (Superintendent Engineer, Alfred Holt and Co., Ltd.), speaking as an engineer, congratulated the Institute on having given a lead to those who have been attempting to discover the cause of the corrosion of condenser tubes, and Mr. May on the progress and extent of his work. As an instance of the value of such work he pointed out how serious a matter it would be if a battleship in war time, were put out of action through the failure of a condenser tube—a contingency which might very well happen. In the mercantile marine business the shipowner had in the past been put to huge expense through condenser tube failures, but the present report, dealing with impingement attack, its causes and some methods of prevention, held out a truly cheering hope that now the nature of the corrosion process had been further studied, the disease had been correctly diagnosed, and that effective treatment could be prescribed. A previous paper on the corrosion and protection of condenser tubes had been of real service to the marine engineering world, but the present report went much further, in that it held out a hope that in the future it might be possible to specify the composition and conditions of a tube truly resistant to corrosion, and to test the finished article in order to prove that it complied with the conditions. Dealing with the work now being done in marine engineering in order to combat corrosion, he said that for the purpose of lessening the concentration of air, the water path through the condenser was designed to provide, as far as possible, an easy, unbroken flow. To prevent de-zincification in tubes of 70/30 or Admiralty mixture, 0·2 per cent. arsenic was added. To prevent erosion, or impingement attack, the size of bubbles was reduced by the fitting of a grid of steel plate ⅛in. thick, drilled with 1in. diameter holes as closely as possible, in the water box at the inlet end. Messrs. Holt had fitted a grid before Sir Charles Parsons had introduced his, though they had done it in a rough and ready way. Continuing, he said that in order to take free air away, large air escape pipes were fitted to the upper part of water boxes. Cupro-nickel tubes of 40/20 alloy were substituted for brass, or brass tubes electrolytically coated internally with chromium were fitted. With regard to cupro-nickel alloys, it was found that 40/30 was a more resistant metal than 40/20, but the alloy with the lower nickel content had been adopted on the score of lower first cost. The mechanism of the three-electrode valve testing apparatus, described in the report, was extremely ingenious, and the statement that the accuracy of the instruments was within plus or minus 1 per cent. was reassuring. In the view of the author's ability to measure the film potential of condenser tube metal, he asked if it would be right to assume that the user might now purchase and fit tubes in a condenser, induce the formation of a protective film by immersing them in sea water, testing to show the increase in film potential as the film formation takes place, and arranging a connection extending outside the condenser to indicate if the film were breaking down, when a change of speed of circulating water or some deaerating device could be brought into play to restore the film-forming conditions. If so, progress was being made at an exhiliratingly rapid rate.

Mr. U. R. Evans said he was glad Professor Carpenter had called attention to the recent brilliant work of Dr. Bengough and his colleagues, and expressed the hope that their paper, in the *Journal* of the Royal Society, which was unique in the history of corrosion research, would receive the careful study it deserved. The rosy future of corrosion research was very largely the outcome of Professor Carpenter's efforts. After expressing admiration for Mr. May's work, and agreement with the interpretation, Mr. Evans suggested that a more complete interpretation of impingement attack could be obtained by applying a suggestion made by Mr. May himself, in conjunction with Dr. Bengough, in THE ENGINEER of July 6th, 1923, namely, that the tendency of corrosion products to arrange themselves round the air bubbles, *i.e.*, at the air-water surface instead of at the metal-water interface, must clearly interfere with scale formation on the metal. A large bubble, on impinging on a brass surface, would probably flatten itself somewhat against the surface, and on leaving the surface might easily pull off part of the skin of corrosion products, exposing the bright brass, as Mr. May had shown. The exposed brass would be anodic towards the film-covered brass around it, as Mr. May had also demonstrated directly, and therefore an electric current would flow and corrosion would occur, until such time as the place healed up by the formation of fresh adherent protective matter. There appeared no need to assume differences in metal-ion concentration, although if the bubbles did carry off metallic ions as well as insoluble products that would increase the electric currents and therefore intensify the corrosion. Small bubbles would not flatten themselves to the same extent, he believed, owing to the additional work which would require to be done against surface tension, and would, therefore, be less detrimental, as Mr. May had found. Commenting on Mr. May's use of potential measurements to follow breakdown and repair of protective films, he said that he himself, in work concerning protective oxide films on iron and zinc, had been using a method based on a similar principle, although, since the changes occurred with those metals very much more rapidly, the experimental procedure was rather different. If at an incipient breakdown the healing forces predominated over the undermining forces, the potential moved in one direction; if the breakdown extended by undermining or otherwise, the potential moved in the other direction. In such cases, if one waited until the corrosion became visible, wide corroded areas were found, whilst in the first case there were microscopic areas or none at all. The fact that the visual observations, when they could be obtained, confirmed the potentiometric observations, increased confidence in the method, and he had no doubt that in Mr. May's hands it would be a most useful and reliable means of appraising quickly the value of different alloys or protective treatments.

Mr. D. H. Hopper said that the jet test, with its potential film measurement, would be a very great help both to engineers and to condenser tube manufacturers. It seemed that manufacturers would now be able to test tubes very much more quickly than formerly, and, assuming that engineers accepted the test as being a useful one, it would be a great help in the production of condenser tubes.

Dr. W. H. J. Vernon congratulated Mr. May on having provided an ideal method of measuring corrosion and an ideal accelerated corrosion test. He also expressed admiration of the extraordinarily interesting results to which the method of measuring film potential had led. A method which enabled one to follow not only the formation, but also the breakdown and subsequent healing of the films, was of the greatest importance. Referring to the curves in the paper relating to aluminium-brass, he said it was suggestive that the same type of curve was obtained with pure aluminium on exposure to air at ordinary temperatures as by the weight-increment method. The self-healing of the film when the latter method was applied was shown by steps in the film, and those steps appeared to correspond with the marked kinks in Mr. May's curves. Mr. May's method was of the greatest value in detecting the breakdown of the film, since it indicated at once the occurrence of even a pin-hole, and a pin-hole might make all the difference between success and failure. He regarded the method as an ideal one because it was quick, it was accurate, and gave a continuous record of the process without interfering in any way with the process itself. Mr. May's jet test also appeared to fulfil all the requirements of an accelerated test without any of the objections with which most metallurgists were all too familiar.

Mr. W. J. Talbot urged that a direction in which engineers might work with a view to getting rid of the serious trouble with condenser tube corrosion was not so much to try to make an old material—brass—good, but to use new materials which were now available.

The President, referring to a remark previously made, that the action of the air bubbles in causing the breakdown of the film might be due to the fact that the film had a tendency to stick to the air bubble, said that if that were correct then the question of the tendency of the air bubble to adhere to the film became of vital importance, and that tendency was capable of modification by adding minute traces of various reagents, as the flotation process had shown. It was quite possible, if what had been suggested was correct, that slight changes in composition either of the water or the alloy itself or of the amount of oil in the condenser, and so on, might have a very large effect in determining the erosive properties of the air bubbles. In froth flotation something was added in order to make the minerals stick to the froth, and in the case of condensers it might be possible to add something to prevent that kind of sticking and so render the air bubbles much less harmful than they might be otherwise.

Professor H. C. H. Carpenter, F.R.S., Chairman of the Corrosion Research Committee, re-emphasised that it had been found wise to separate the purely scientific study of the problem from the study of its practical applications. The former work was being carried out under the direction of the Department of Scientific and Industrial Research, and the latter by the original Committee, but there was the closest co-operation between the two bodies. Professor Carpenter added that the credit for the work done on the aluminium-brass alloy was due to Mr. Wolseley, of Charles Clifford and Son, Ltd., and expressed regret that this acknowledgment had been omitted from the paper. With regard to the cost of the work, he said the Committee had been very well supported by the manufacturers, who had borne by far the larger share of the cost. He made an appeal to all engineers who were concerned with the problem, and particularly those in Liverpool, where shipping was so vital an industry, to support the work also.

Mr. May replied to the discussion. Dealing with the necessity for keeping tubes clean, particularly in the case of tubes having an artificial protective film, he said that that artificial film might consist of metal, such as tin, nickel or chromium. Most of those metals—indeed he supposed all of them—were more noble than the metal beneath the film, and if the film were injured in any way the metal would corrode. If the cleaning were drastic, as, for instance, if steel brushes were used, there was every chance of injuring the protective film, and as he understood that the use of steel brushes was becoming more and more prevalent, it was most important that a material with a naturally forming film should be adopted. One material mentioned in the paper, one which was in process of development, was brass containing aluminium. With regard to the immersion of tubes in sea water as a means of forming a protective film, he said that could be done with the ordinary 70/30 brass tube, and, provided the film remained intact, it would resist very violent conditions. The difficulty in practice, however, was to immerse the tubes in sea water under the necessary favourable conditions. Commenting on Mr. Hopper's remarks, he said he was glad to hear that the tube manufacturers were looking with favour on the use of the jet test apparatus. Discussing de-zincification, he said it was mentioned in the report, and a statement was made, that once de-zincification had started it tended to prevent other types of corrosion taking place. Generally speaking, that seemed to be the case. In ordinary sea water corrosion, and also in special cases where there was electrolytic action between various portions of the condenser, it was quite possible to get de-zincification or copper deposition, which was the same thing, in tubes.

The next paper to be taken was one on "Corrosion by Discontinuities in Metallic Protective Coatings," by Mr. U. R. Evans, of which we give a *précis*.

CORROSION AT DISCONTINUITIES IN METALLIC PROTECTIVE COATINGS.

A study has been made of the corrosion occurring at different kinds of discontinuities in coatings of non-ferrous metals on steel; the work has included sprayed coatings of copper, nickel and aluminium, and, in addition, coatings of zinc and zinc-iron alloy produced by hot galvanising, electro-deposition, spraying, and sherardising. Various thicknesses of coating were employed and

* No. I. appeared September 7th.

the specimens were subjected to six different types of corrosion.

The cracks produced by bending are more dangerous than uniformly distributed pores. If the coating metal is cathodic to steel the steel is corroded; copper under some conditions causes marked acceleration of the corrosion of steel at exposed places, nickel being less dangerous. If the coating metal is anodic to steel, the coating suffers corrosion preferentially, the steel thereby receiving protection; thus steel coated with zinc usually suffers no corrosion even at cracks until the zinc becomes exhausted. Steel thickly covered with zinc usually fares better than thinly covered steel, notwithstanding the greater tendency to cracking; old galvanised sheet carried more zinc than the modern material and generally lasted longer. Coatings of aluminium or zinc-iron alloys are themselves less attacked than coatings of free zinc, but for that very reason they afford less sacrificial protection to the underlying steel in certain waters. Zinc itself is rather rapidly attacked when partially immersed in a chloride solution, but alternate salt spraying and drying was found to build up a protective film—a fact which explains certain observations made on the behaviour of galvanised iron in service.

Mr. E. A. Atkins, opening the discussion, said the statements in the paper referred only to the particular specimens Mr. Evans had tested, and he warned metallurgists not to read into the paper more than was intended. Those who had experience of the coating of metals knew that there were many factors affecting the coating and the resulting corrosion. In illustration he referred to the electro-galvanising and the hot galvanising processes. In electro-galvanising there were at least a dozen factors which had to do with the resulting coating and its life. In hot or cold galvanising the analysis of the base metal, its micro-structure, its physical condition, and the condition of the surface of the base metal previous to coating, were all important. As to the coating method, in hot galvanising there were eight or ten different factors, all of which affected the result. A thin brittle coat or a thick flexible coat could be got by appropriate treatment. The difficulty with regard to producing the best possible quality of galvanised material was that people would not pay the price for it. He believed that efforts were made in America to produce a galvanised article of the highest possible quality, but it could not be sold.

Dr. W. H. J. Vernon, dealing with the formation of protective coatings during exposure to ordinary atmospheric conditions, said that there was a marked tendency for such protective coatings to form on copper, but so far as his experience had gone there was little or no such tendency in the case of zinc. Dealing with Mr. Evans' reference to Patterson's work, he said that in the experiments quoted Patterson had exposed his specimens to an atmosphere completely saturated with water vapour and under completely stagnant conditions, and a definite falling off in the rate of attack was observed. It did not follow, however, that a film so produced would be protective under conditions of exposure to wind and rain. It was possible, indeed, that the coating might be removed by the first shower of rain. With regard to the protective coating obtained by alternate spraying with acid and exposure to dry air, it was noteworthy that the resistance was tested in a dilute solution of sodium chloride. In this country the influence of the sulphate radical predominated and obscured the effect of the chloride radical. In a marine atmosphere, remote from an industrial district, the chloride radical would have the greater effect. He doubted whether the protective coating obtained by Mr. Evans in the manner indicated would stand in the London atmosphere.

Mr. Evans, replying, expressed appreciation of Mr. Atkins' warning that one should not read into the paper more than was intended. With regard to the suggestion that people would not buy the more thickly coated material, he said that if an authoritative and impartial body made the statement that it was worth the extra cost he was inclined to think there was likely to be a future for it.

A paper by Messrs. Gwyer, Phillips and Mann, entitled "The Constitution of the Alloys of Aluminium with Copper, Silicon and Iron," was then presented.

THE ALLOYS OF ALUMINIUM.

After a brief summary of recent work on the binary alloys of aluminium with copper, silicon and iron, the constitution and structure of part of the ternary systems aluminium-copper-silicon and aluminium-copper-iron are considered. The former of these is shown to be eutecti-ferrous, with a ternary eutectic of $CuAl_2$, aluminium and silicon, containing 26 per cent. of copper, 6·5 per cent. of silicon, and freezing at 525 deg. Cent. The aluminium-copper-iron system is shown to be rather more complex; a peritectic reaction occurs at 590 deg. between $FeAl_3$ and liquid resulting in the formation of a constituent isomorphous with "X;" the latter forms a ternary eutectic with $CuAl_2$ and aluminium, containing 32·5 per cent. of copper, 0·3 per cent. of iron and freezing at 542 deg. Cent. The structure and constitution of certain of the quaternary alloys of aluminium with copper, iron, and silicon are also considered. The constituents present in addition to $CuAl_2$ are those of the aluminium-silicon-iron system, and a quaternary eutectic occurs at 26 per cent. copper, 6·5 per cent. silicon, 0·5 per cent. iron, freezing at 520 deg. Cent., the constituents being aluminium, $CuAl_2$, "X," and silicon. The paper deals exclusively with metastable conditions.

Dr. W. Hume-Rothery asked that the actual figures on which the authors' diagrams and curves were founded should be included in the paper before final publication, because in the early work a large number of mistakes had crept in owing to the habit of the early workers of producing smooth curves. There was always a chance that there might be a mistake somewhere.

The President said he did not think the authors claimed that their constitutional models and diagrams represented equilibrium conditions.

A paper entitled "Laboratory Experiments on High-temperature Resistance Alloys," by Messrs. Smithells, Williams and Avery, was then presented.

HIGH TEMPERATURE RESISTANCE ALLOYS.

A series of nickel-chromium alloys containing from 10 to 60 per cent. of chromium, and a few ternary alloys containing tungsten and molybdenum, have been made from specially pure materials melted in hydrogen. They have been subjected, together with some commercial nickel-chromium alloys, to new forms of test for resistance to oxidation and resistance to sag at high temperatures.

For the binary alloys resistance to oxidation increases with increase of chromium content up to 30 per cent. With more than 40 per cent. of chromium a second phase appears and resistance to oxidation falls. Ternary alloys containing only 10 per cent. of chromium show low resistance, whilst those containing 20 per cent. of chromium show high resistance to oxidation. The composition of the oxides formed on the alloys has been determined by X-ray analysis. For high resistance to oxidation the oxide layer must contain at least 50 per cent. of chromic oxide. The composition of the oxide layer is determined by, but is not generally the same as, the composition of the alloy.

For the binary alloys resistance to sag at high temperatures decreases with increase in chromium content. The ternary alloys sag more than the binary alloys having a similar nickel content.

The presence of small amounts of impurities has a marked effect in lowering both the resistance to oxidation and sag. Commercial alloys are inferior to the experimental alloys, having the same nominal composition, for this reason.

The electrical resistivity of all the alloys has been determined between 20 deg. and 1000 deg. Cent.

Mr. P. D. Oakley said the paper provided an excellent illustration of the way in which a very special equipment could be applied to a purpose kindred to its original purpose, but outside its normal scope. The apparatus used was specially associated with lamp making, but it had proved most valuable in this particular research on resistance alloys. That suggested that others having specialised equipment might use it with advantage for the elucidation of other problems outside its normal scope. With regard to the materials, he said it was noted in the paper that the reduced nickel gave worse results than electrolytic nickel, and yet the difference in purity seemed to be very slight. But the nickel oxide was reduced in nickel boats at a lower temperature than was used for melting the electrolytic nickel, and the latter was melted in sillimanite boats. If the difference were due to impurities in the reduced nickel they must have been present in the nickel oxide. The statements in the paper with regard to sodium chromate were puzzling, and he asked where the sodium came from. A rough calculation suggested that if the loss in weight due to sodium chromate was of the order of the gain in weight due to oxidation, the sodium must amount to about 25 per cent. of the weight of chromium oxidised. That seemed tremendous. Finally, he asked if the authors had information connecting temperature with life.

Owing to the shortness of time, the authors were asked to reply in writing.

A paper on "The Copper-magnesium Alloys," by Mr. W. R. D. Jones, and one on "The Rockwell Hardness Test," by Mr. J. E. Malam, were taken as read.

LUNCHEON.

After the morning session the members and their ladies were entertained to luncheon at the Adelphi Hotel by the local members and industrial and other firms. Professor C. O. Bannister, Chairman of the Reception Committee, presided.

After the loyal toast had been honoured the toast of "Science and Industry" was proposed by Captain J. R. Hobhouse, M.C., of Messrs. Alfred Holt and Co., who pointed out the dependence of industry upon science and prophesied that in the next decade or so we should see the scientific man coming into his own. The test of the technical man, he said, was his capacity to make his problems understood by enlightened and interested laymen, and it would be a good thing for industry if the scientists laid themselves out to be more convincing, and perhaps less modest, than they had been. It was necessary that there should be an appreciation of the value of science and its applications to industry, not only in the minds of the managers of industry, but also in the minds of the foremen. The latter must be taught that their distrust of theory and their complete reliance on practice was wrong, and that progress could only be achieved by close co-operation between the students of theory and the practical workers.

The President, responding to the toast, ventured to suggest that the men who were responsible for the guidance of industry should take the trouble to obtain enough knowledge at any rate of the language and the elementary substratum of science, in order that they might be able to appreciate the value of science. The scientific worker must use scientific language, and it was not possible for him to express his results in language which would be intelligible to everyone. If they tried to avoid its use they would have to go a very long way round in order to explain themselves. Therefore the President pleaded for tolerance on both sides. He believed that there was no country in the world where more successful scientific research was carried out than this. He wished he could say with equal conviction that there was no country in the world where the results of science were appreciated and applied as in this country.

In the afternoon the members and their ladies visited various works in the Liverpool area, and in the evening there was an entertainment and dance, arranged by the local Committee.

The reading and discussion of papers was resumed on Thursday, September 6th, at the Adelphi Hotel.

The first three papers dealt with concerned the work which has been done under the auspices of the Die-Casting Research Committee of the British Non-ferrous Metal Research Association, in connection with the die casting of alloys of the brass type (of comparatively high melting point), alloys of aluminium (of the intermediate melting point), and alloys of the base metals (of low melting point). These three papers were as follows:—"Diecasting of Copper-Rich Alloys," by Messrs. Genders, Reader and Foster; "Properties and Production of Aluminium Die-castings," by Messrs. Archbutt, Grogan, and Jenkin; and "Die-casting Alloys of Low Melting Point," by Messrs. Russell, Goodrich Cross and Allen.

We give below the official abstracts of these three papers.

DIE CASTING OF COPPER-RICH ALLOYS.

The paper deals with the results of some sections of a general investigation of the die casting of copper-rich alloys. Exploratory examination of a wide range of alloys in the form of chill-cast bars and die-cast test pieces has indicated that a variety of alloys exists, suitable for die casting and offering mechanical properties to meet varying requirements. The aluminium brasses, which were examined in greater detail, have advantages in their range of properties, high proof stress, slow rate of attack on mould and core materials, and cheapness. Mould and core materials were tested by immersion in molten alloys, both at rest and in continuous motion. High-carbon steel and special steels of the heat-resisting type showed little deterioration under the conditions of the tests, while low-carbon steel and engineering steels were rapidly attacked. The behaviour of cast iron in molten aluminium-bronze was largely influenced by the phosphorus content of the iron.

PROPERTIES AND PRODUCTION OF ALUMINIUM DIE CASTINGS.

The paper describes investigations into (1) production and properties of aluminium alloy "die castings" made in permanent metal moulds under gravity feed, *i.e.*, without application of external pressure; (2) hot shortness of aluminium die casting alloys.

(1) Five alloys have been employed in the study of die casting, namely, 4 per cent. Cu, 8 per cent. Cu, 12 per cent. Si, 4 per cent. Cu, 3 per cent. Si, and Y alloy.

Two types of casting have been investigated: (*a*) a shouldered test piece of circular section suitable for testing direct without machining; (*b*) a hollow tubular casting requiring the use of cores in moulding, and incorporating flanges and changes of section, features which cause difficulties in casting. Design and treatment of moulds and conditions of working in respect to mould temperatures, pouring, stripping, &c., and the effect of the different alloy compositions on these are described together with the testing and properties of the castings obtained. To overcome defects due to air locks, shrinkage, sticking of cores, &c., very careful control of the working conditions was necessary, including metal and mould temperatures, rate of pouring, interval between filling the mould and operations of drawing cores, opening the mould and stripping.

By means of a practised team of workers these operations were carried out with the degree of accuracy needed, and considerable success was thus obtained. Satisfactory castings were produced in the tubular form from all the alloys studied. With the test piece form castings of satisfactory mechanical strength were obtained in Y alloy, 12 per cent. Si, and 3 per cent. Cu 4 per cent Si, but less satisfactory results were obtained with the binary copper-aluminium alloys owing to hot shortness.

(2) In the investigation into hot shortness the same five alloys have been studied together with L5 alloy ((Cu 2·5–3·0 Zn 12·5–14·6 per cent.). The energy absorbed in fracture of an unnotched test bar cast to shape is taken as a measure of the hot shortness. Some tests were made on freshly cast bars as they cooled down, but the results mainly relate to bars re-heated to a steady temperature.

Hot-shortness is only exhibited at temperatures close to the temperature of commencement of melting. Within narrow temperature ranges the impact strength falls rapidly from the maximum striking energy of the machine to zero or nearly so at the commencement of melting. The range over which the rapid fall in impact strength takes place varies from 5 deg. Cent. with the 12 per cent. Si alloy to 45 deg. Cent. with L5.

DIE CASTING ALLOYS OF LOW MELTING POINT.

Sixteen zinc-base alloys, having either copper and tin or copper and aluminium, and—in some cases—with further additions of either nickel, cadmium, lead, or magnesium, have been examined microscopically and thermally, and their densities determined. Pressure-cast flat test pieces were made of each of the alloys and examined for tensile strength, hardness, bending, and for porosity, with special reference to the influence of the casting temperature, the temperature of the mould, the size of gate and vent, and the type of pull on the lever of the machine. The porosity depends almost entirely on the kind of pull on the lever, but the differences due to the kind of pull become less as the gate is opened. The copper-aluminium-zinc alloys are approximately twice as strong as the copper-tin-zinc alloys. For any one alloy the casting conditions—within reasonable limits—have only a small effect on the tensile strength when compared with the influence of the form of the test piece and of non-axial loading.

The effects on the strength and on the permanency of dimensions after atmospheric ageing have been investigated and a very large number of tests of the so-called "accelerated ageing" type have been made. The "accelerated ageing" consists in subjecting the castings to the action of hot air, hot air saturated with moisture, and to steam at 100 deg. Cent. The general conclusions are set out; the most important one being that within the limits of the compositions examined, the effect of the chemical composition on the rate of growth is insignificant when compared with the effect of the form and mechanical condition of the actual casting.

Work on the action of molten zinc and of zinc alloys on different ferrous materials was unfortunately left in an unfinished condition, and only the results of the action of molten zinc are given.

The President, speaking as Chairman of the Die-Castings Committee, explained the purpose of the work described in the papers, the mechanism by which it was carried out, and what it was believed had been attained. The die-casting industry, some years ago, had not been in the flourishing condition in which it was desirable that it should be, and those who had been responsible for the work had had a kind of mandate from the industry, which had co-operated most cordially and helpfully, in order to ascertain in as authoritative and reliable a manner as possible the properties which could be relied upon as being obtainable in die-castings. The mechanism of die-casting, whether under pressure or otherwise, and questions of mould design and mould material, were of a secondary character for the purpose of that research; those questions had to be studied just so far as was necessary to produce satisfactory castings for testing. The result of the work was that there had

been attained, for a number of well known die-casting alloys—using the term "die-casting" in its broader sense, *i.e.*, the production of small castings in permanent moulds, whether under pressure or otherwise—a set of data representing the kind of result which could be obtained and relied upon, and those responsible for the work had been assured by the industry that the availability of such data had already reacted favourably on the use and development of die-castings in this country. There were other problems which opened up avenues for research, questions such as the behaviour of the mould and machined materials when in prolonged contact with molten metal, the precise effect on the physical properties of the resulting casting produced by the application of pressure, the amount of pressure, and the stage in the process at which the pressure should be applied. All these questions had to be determined, at any rate for the two higher melting-point groups of alloys, and that was a lengthy business. Therefore, it should be appreciated that the work described was limited by design to a particular range of questions, and it must not be regarded as a general investigation of the whole of the wide problems of die-casting.

Mr. A. H. Mundey, in the name of a group of men engaged in the die-casting industry, thanked the authors of the papers for having published so much valuable information, and the President for having set the seal of approval on die-casting generally. The die-casting industry had suffered a serious set-back as the result of a lot of bad work twenty-five years ago, and it had been difficult to make up the leeway. Users of die-castings now, however, as the result of the information in the papers, could rely upon getting an article which was what it purported to be. The die-casting industry did need the confidence of those who used die-castings, and the latter, after reading the papers, could give their orders with confidence. Discussing the die-casting of the low melting point alloys, he said the casting temperature, temperature of mould, size of gate and vent, and type of pull, were all very important variables, but they depended very largely on the size and character of the castings to be produced. In a general way it was an axiom that the metal should be at as low a temperature as could be conveniently worked, and that the mould should be as warm as could be conveniently worked. The mould should be cool enough to promote ready solidification, and warm enough to allow the whole of the metal to get in before it began to solidify. With regard to size and character of gate, the craftsman was the main guiding factor, and that matter was occupying the attention of the designers, and the craftsmen working with them, very seriously indeed. In view of the extremely complicated character and form of die-castings, no standardised form of gate could be adopted. The type of pull of the lever operating the plunger needed differentiation, and the skill of the workman was highly important. If a dozen men were working the levers, each of them would operate the levers in a somewhat different fashion. With regard to viscosity, he said it was being found that the more viscous alloys of zinc-aluminium-copper could be cast in the same conditions as the pressure die-castings in aluminium and aluminium alloys most successfully. The problem of mould materials was one of the greatest troubles. The high speed steel which had to be used for cores was expensive both to buy and to machine, but up to the present it was the only material that could be used for fine cores.

Dr. F. Johnson discussing the paper on the copper-rich alloys, asked if the authors had heat-treated the die-cast specimens, because it seemed to him that they really would benefit by a form of heat treatment. With regard to the statement that high-tensile aluminium-brass cost slightly more than the aluminium-bronzes normally used, he said he could not understand why that should be so. With reference to the author's tests, in which various bars of mould materials were immersed in molten alloy—both aluminium bronze and 60/40 brass—for an hour, he suggested that the period of immersion was not sufficient to give an indication of the life of the bars in service. A chromium-plated steel, for instance, might stand up to the test quite satisfactorily for an hour, but it was doubtful whether the coating would be sufficiently resistant for works service. He suggested that much longer periods of test were necessary.

Mr. R. B. Deeley (Messrs. Light Alloys, Ltd.), said that both he and his chief, Mr. W. H. Grieve, felt it was unfortunate that it was not made more clear that the aluminium-silicon alloys were at least as good as the other alloys mentioned in the paper on aluminium alloy die-castings. One of the illustrations (of a 12 per cent. silicon alloy), for instance, conveyed the impression th t the aluminium-silicon alloys were particularly subject to shrinkage cavities, but he suggested that in the casting in question the shrinkage was due largely to the design of the die, and he had been informed by the authors that after altering the die and having larger runners and risers, satisfactory aluminium-silicon castings were produced. At his works they had been manufacturing and using tubular castings in those alloys for a number of years, and the results obtained were very much the same as the authors' results for the chill cast bars. With regard to test pieces cut om the castings, he said the authors' results were at least a ton per square inch lower than those obtained at his works.

Mr. J. G. Pearce, Director and Secretary, British Cast Iron Association, said that the comparative lack of attention paid to the question of the mould material was a somewhat disappointing feature of the papers. The properties of the mould material, the design of the mould, and methods of practical operation, had an important influence on the structural properties of the die casting, and, as hinted in the paper on the copper-rich alloys, the cost of mould material and the life of the mould might be determining factors in the economics of the die casting process. So pronounced was that influence that the mould and the casting could scarcely be considered independently. The success which had attended the use of cast iron for moulds for many years past, combined with its cheapness as compared with any possible alternative material, warranted its exploitation to the greatest possible extent. It was rather extraordinary that no attempt appeared to have been made to use heat-resisting irons, although free use was made of heat-resisting steels. In the copper paper the cast irons were shown in the immersion tests to have behaved extremely well, with the exception of the bar containing high phosphorus, but the result on that bar was scarcely comparative, as it appeared to contain very little combined carbon. Existing experience would suggest the avoidance of alloys containing phosphorus, and more informative comparisons could have been made on a series of true heat-resisting irons. Unrepresentative irons made an extraordinarily good showing compared with steels and special materials. The use of permanent cast iron moulds for making chilled iron castings had been common for many years in the manufacture of both very large and very small parts, and in the manufacture of steel ingots, and a considerable technique had been developed in respect of the composition and design of the moulds and methods of operation. The conditions of operation for making chilled iron castings and ingots were much more severe on the mould than in any branch of die casting. Furthermore, the British Cast Iron Research Association had during the past few years devoted considerable attention, from the metallurgical and practical points of view, to the general problem of irons to resist heat, and its recommendations, when put into operation by competent founders, were being followed in various applications with considerable success. It was somewhat surprising, therefore, that, although the Association was represented at the original conference at which the work was initiated, no attempt had been made to invoke the co-operation of the Association. That could have been done without necessarily involving additional expenditure. On the other hand, any attempt to develop commercially the results so far obtained without taking such existing knowledge and experience into account would inevitably result in unnecessary expenditure for experimental trials.

Mr. J. Cartland said the information in the papers would be definitely helpful to manufacturers. From experience he had found that it was quite the exception to be able to produce satisfactory castings from a die at the first attempt. There were many variables. The authors of the paper on aluminium alloy die castings had mentioned six, and he added another two—the position and size of the gate. Even if there were only a small range of variability in each, there was a very large number of combinations, and that meant that in practice there was generally a considerable amount of trial and error before satisfactory castings were produced. Once the correct metal and mould temperatures, pouring rate, stripping intervals, and so on, had been determined by experiment, however, it was remarkable how well the operators were able to maintain those conditions sufficiently well to be able to produce regularly satisfactory castings for a very long period. The authors had dealt with metal composition as a constant, but in practice that factor was one which could be varied by the producer. Dealing with die castings of the high-temperature alloys, he expressed the conviction that there was a very big field for their use as soon as their potentialities and their limitations were better understood by users. He included the limitations advisedly, because there were some users who expected more from such die castings than they should do. The authors had made out a very strong case for aluminium-brass, and he would like to use that material more, because it was cheaper, easier to machine, involved lower temperature, less fuel consumption, and less wear on the moulds than in the case of aluminium-bronze; there was also the possibility of soldering it. So far, in ordinary works practice, he had not managed to make regularly satisfactory finished castings in aluminium-brass, whereas satisfactory castings could be made fairly regularly in aluminium-bronze. Possibly, however, regularity with the aluminium-brass would be attained with further experience. With regard to mould material, he said that generally he used a high-speed steel, but whereas the material supplied by one manufacturer stood up to the work very well, that of another manufacturer did not.

Mr. W. E. Alkins, asking for information as to the possibilities of die casting copper of high conductivity, said there was undoubtedly a potential field for it. It would find application in the manufacture of various specialised types of rail bonds used in electrified tracks, and also in the manufacture of a number of accessory fittings for use in connection with overhead transmission in railway electrification. In both cases high electrical conductivity was a primary consideration.

Dr. R. S. Hutton, Director, British Non-Ferrous Metals Research Association, said that probably there were some who were apt to be a little more critical of the results obtained than was justifiable, but it must be remembered that during the progress of the research a great deal of industrial advance had been made; the position at the time the researches were started, four or five years ago, was very different from what it was to-day. The majority of the firms concerned with that section of the industry had been intimately connected with the progress of the research from the beginning and had contributed substantially to the results obtained, whilst he believed the investigators themselves had had no small influence on the industrial progress of the individual firms concerned. At the beginning there was a distrust of the wider application of the alloys investigated; he believed a good deal of that distrust had been dispelled, and there were possibilities of much wider uses and applications than had so far been achieved in this country. Emphasising the important part played by the designer and toolmaker in achieving the desired results, he pointed out that that was a very highly skilled craft; the predominant position of any individual firm in die casting depended not only on a knowledge of the right materials, but also in employing and encouraging a really first-class team of designers and toolmakers. With their help it was hoped that substantial progress would be made.

The President, after expressing congratulations upon the practical character of the discussion, said it was nearly always stated, when papers giving the results of laboratory researches were discussed before that and other institutions, that the results obtained in the laboratories could not be obtained in the works. In the present case, however, it had been stated that better results could be obtained in the works than were obtained in the laboratory, and he believed that no one would be more delighted at that state of affairs than were the research workers themselves. It was better that that should be so, rather than that the research workers should put forward figures which could be obtained by the practical die casters only under optimum conditions.

Dr. R. C. Reader, replying to the discussion on the paper dealing with the copper-rich alloys, dealt first with the question of heat treatment. Heat treatment experiments, he said, were carried out on chill cast bars, and it was found that the improvements obtained—if any—were not worth while. Since the die casting, as regarded the brass at any rate, was only a chill casting in another form, it was assumed that in that case also the improvements achieved by heat treatment would not be worth while. With regard to the immersion of test bars of mould and core materials in molten alloy and the suggestion that immersion for one hour was not sufficient, he said that after immersion for one hour there were quite large differences in the amount of attack of the specimens, and it appeared that the period was quite long enough; the test was quite severe. The chromium-plated bars were immersed for three hours, which was exceptionally severe. The chief drawback to chromium plating was that it flaked off as the result of constant expansion and contraction. As to the cost of aluminium-brass, he said the first high-tensile brass made by the authors contained manganese, and while it was quite likely that that particular alloy was cheaper in first cost than aluminium-bronze it was found by a particular manufacturer to be dearer in the end; he had had trouble with it and could not get the composition quite right. With regard to the die casting of high-conductivity copper, the only alloy he could recommend for electrical conductivity purposes such as were mentioned by Mr. Alkins was copper with a very small percentage of silicon. He had seen it used in America for such purposes, and the users were quite satisfied with the results.

Mr. J. W. Jenkin replied to the discussion on the paper dealing with the aluminium alloy die castings. With regard to the localised shrinkage in the 12 per cent. silicon alloy referred to by Mr. Deeley, he said that although the authors admitted that a different design of die might have made some difference within the limits they had used they had obtained that shrinkage effect, and could only get over it by altering the mould temperature. Alteration of the design of the die was not within their purview, although they had realised the effect on the properties of the castings. It was encouraging to hear that the results obtained by Mr Deeley in the works were at least 1 ton per square inch better than those obtained by the authors of the paper on tubular castings. He pointed out, however, that the test pieces of tubular castings, as used by the authors, were very small indeed, and a small flaw would make a very considerable difference to the tensile strength. It was encouraging to know that the work would be useful to manufacturers, and he was glad to have Mr. Cartland's confirmation of the authors' conclusion that each casting had to be studied individually.

Dr. O. F. Hudson, on behalf of the authors of the paper on the low melting point alloys, who were unable to be present, said they would reply in writing.

A paper entitled "The α-Phase Boundary of the

GENERAL VIEW OF CABLEWAYS AT NAG HAMMADI BARRAGE

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Copper-silicon System," by Dr. C. S. Smith, was then presented. The author has re-determined the α-phase boundary of the copper-silicon system by a series of annealing and quenching experiments. The solubility reaches its maximum value, 6·7 per cent. silicon, between 721 deg. and 782 deg. Cent. At 852 deg. Cent.—the temperature of the peritectic horizontal—the solubility is 5·25 per cent., while at 400 deg. Cent. is only 4·1 per cent. silicon.

In the discussion Professor T. Turner, Past-President, as an instance of the importance and practical value of work such as that described by Dr. Smith, referred to a process he had seen at work at Port Pirrie, South Australia, recently, in connection with the extraction of silver from lead. The alloy which contained about 1000 oz. of silver per ton, was introduced continuously into the apparatus, and the proper temperature was maintained. The apparatus separated the alloy into two solutions, one being rich in lead and the other containing silver and gold. The richer solution contained 10,000 oz. of silver to the ton and could be dealt with more easily than the original alloy. That process was the result of a study on similar lines to that discussed by Dr. Smith in his paper.

The President, commenting on the purity of the silicon used by Dr. Smith—99·18 per cent.—pointed out that some time ago the National Physical Laboratory had published particulars of a simple method of producing silicon of very much higher purity. It was a pity that Dr. Smith's work had not been done with a silicon of higher purity than that used. Recent work by some American metallurgists working with aluminium and using silicon of very high purity had shown that there were very definite effects on solid solubility particularly owing to the presence of small amounts of a third element. That, he believed, would have to be taken into account before the chapter of the copper-silicon alloys was finally closed.

Dr. Smith, replying, said he was ignorant as to what the impurities in the silicon were, but he believed a large proportion consisted of silica, which would not enter into the alloys when made up, except as a non-metallic inclusion. The silicon he had used was supposed to be the purest he could obtain in reasonable quantity.

A paper entitled "Note on Practical Pyrometers," by Messrs. Brook and Simcox, was then discussed.

The paper outlines difficulties, such as stray current and magnetic fields of great intensity, which are peculiar to industries where large currents are used. An instrument has been designed which eliminates these and is accurate even when placed in the field surrounding a conductor carrying as much as 20,000 ampères. Various minor difficulties are dealt with and a description is given of a quick-reading thermo-couple which is suitable for use in non-ferrous foundries.

Dr. J. L. Haughton, dealing with the accuracy of reading of the scales on the instrument described, questioned if it were possible to obtain much greater accuracy of reading by mere magnification of the scale. He suggested that there must be some optimum apparent distance between the two divisions to give maximum accuracy in reading, and asked if it would not pay to introduce a graticule into the eye-piece.

Mr. R. Genders said that manufacturers would make more use of scientific control if instruments of the kind described in the paper were available. The instrument should be very serviceable. At Woolwich, for some years, an instrument similar to that described in the paper had been used for measuring casting temperatures in brass, but the bare portion of the thermo-couple was painted with a thin layer of fire-resisting cement after each reading. That did not interfere with the rapidity of reading, but it afforded considerable protection to, and prolonged the life of, the thermo-couple.

Mr. F. Adcock, asked whether the currents which were referred to by the authors as having a disturbing effect upon the instrument were direct or alternating currents; the latter might have some effect. He also referred to the increasing use of high-frequency currents and said he had noticed that earthed objects near high-frequency circuits would burn one's hand if one touched them and emit small sparks; such a discharge might upset the rather delicate parts of galvanometers. Another suggestion was that oil might possibly cause defects in insulation, and in many cases should be looked upon with suspicion.

Mr. N. F. S. Hubbard asked if the authors knew of any suitable couple for taking temperatures above 1000 deg.

Mr. H. Brook Freeman referred to the disturbance of recorders owing to electrical currents. The mechanical zero of a recorder used at his works had given readings from day to day which did not agree with the temperature at the cool end of the junction and the trouble was traced to the lights which were used to illuminate the instrument. If the lights were hung over the recorder on the right-hand side the zero would move probably 40 deg. to the right, representing a drop of 40 deg. in temperature. If the lights were moved to the other side there was a movement representing a rise of 40 deg. although the actual temperature in the junction box did not alter. It was suggested that the effect was due to convection currents, and the difficulty was overcome by encasing the instruments and lighting from the outside.

Dr. H. Hyman said he had obtained fairly uniform and successful results with a chromel-alumel couple, and suggested that it would last longer than copper-nickel wire.

Mr. Simcox, replying to Dr. Haughton's remarks with regard to the magnification of the scale, said the idea was to make it as visible as possible. The instrument was sunk in a plate and, if there were no lens, the trained boys who had to use the instruments would be liable to make considerable error. The suggestion to use a graticule was certainly one which the authors would consider, for there were considerable possibilities in it. The temperatures which the authors were measuring were considerably lower than those to which Mr. Genders was accustomed, and the painting of the wire with some sort of wash would certainly be necessary for higher temperatures. Replying to Mr. Adcock's question as to the nature of the disturbing currents, he said the authors had used direct current and had had no experience of alternating current so far. For a couple to measure temperatures above 1000 deg. he suggested a nickel-nicrome or a chromel-alumel couple. Obviously Mr. Genders had a couple which would suit Mr. Hubbard's purpose. The authors had experienced trouble with convection currents, such as was suggested by Mr. Brook Freeman, and had traced it to a lamp hanging a considerable distance from the recorder. It was overcome, however, by placing a glass screen just in front of the indicator of the recorder. Replying to Dr. Hyman, he said that although chromel-alumel would give a longer life than would the copper-nickel wire used by the authors, he did not think it would be such as to compensate for the extra cost.

Owing to shortness of time several papers were taken as read.

In the concluding business of the meeting a suggestion was made by the President that, as a result of the meeting, there might be formed a Lancashire or South Lancashire Local Section, meeting either in Manchester or Liverpool, for there was a large membership in Lancashire. In that connection he recalled that, following the autumn meeting at Swansea a few years ago, a local section of the Institute had been formed there, and it had done much valuable work.

Cableways for the Nag Hammadi Barrage.

IN our issue for September 2nd, 1927, we published a description of the Nag Hammadi Barrage, which is being built across the Nile between Assuan and Assiut, under the supervision and to the designs of Messrs. Coode, Fitzmaurice, Wilson and Mitchell, of Westminster. The contractors for the structure—Sir John Jackson, Ltd.—having decided that the best means of handling materials, &c., was by a system of cableways, consulted John M. Henderson and Co., Ltd., of Aberdeen, and as a result the latter firm designed and constructed an equipment of five "Luffing" cableways, which have several features of interest. The equipment, the design of which was approved by the consulting engineers, to whom all proposals for carrying out the work had to be submitted, is illustrated in the accompanying engravings and in the view on page 288.

The cableways are erected across the Nile at right angles to the stream and are disposed so as to command practically the whole area of the barrage structure, which is about 3000ft. long by 340ft. wide. This made it necessary for each cableway to have a clear span of 3100ft., which is believed to be considerably greater than that of any previous cableway of this type. Each cableway is designed to handle a load of 5 tons on the hook, though in actual working they have, we are informed, frequently handled heavier loads than that on continuous working.

The diagram—Fig. 1—shows the disposition of the cableways in respect to the barrage, the section of which is shown hatched. It was required that the loaded hooks of the cableways should be 14ft. above the cope level of the barrage at the centre of the span, and, to ensure that, it was necessary to make the supports or masts 183ft. high. Some idea of the size of these cableways is conveyed by the statement that their permanent equipment—i.e., apart from erection ropes or spares—includes over 22 miles of wire rope.

The great height of the supports and the weight of the main cable made it necessary to consider carefully the best and quickest method of erection. For the supports it was decided to adopt the method which Messrs. Henderson had previously used on a number of similar occasions for this type of cableway support, and special tackle was designed and supplied by them for the purpose. The supports were erected in the following manner:—

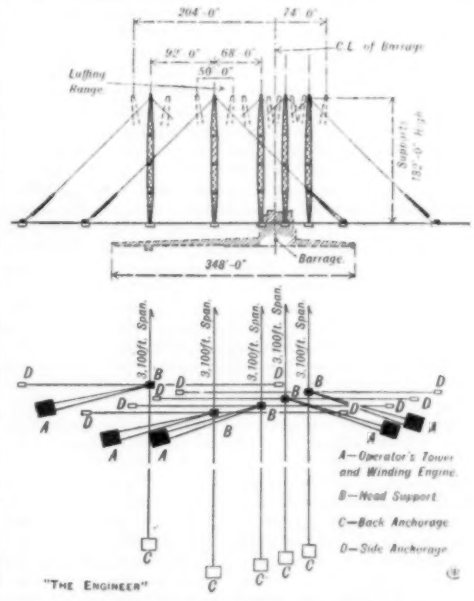

FIG. 1—DISPOSITION OF CABLEWAYS

Each support was completely assembled while lying on the ground at right angles to the line of the cableway. The base, with its ball pivot, was packed upon timber baulks, and was supported on temporary steel brackets by a steel pin passing through the base of the support, so that it was free to turn in a vertical plane. The base was then anchored in this position by wire ropes to the foundations of the side-luffing winches. Next, a pair of light steel derrick poles was erected about 125ft. from the base of the support, one on each side. These poles were joined at the top by a pair of rolled steel channels, from which were hung two 7½ tons worm-geared blocks, by means of which the support was raised as high as possible, i.e., to an angle of about 15 deg. with the horizontal. For the next stage a steel derrick pole, 80ft. high, with two guide rope sheaves at the top, was used. It was erected about 10ft. from the base of the support and firmly held in a vertical position by guy ropes. A double rope trop was attached to the support at about 125ft. from the base and passed over the sheaves on the top of the 80ft. derrick pole to a porting pulley connected by link plates to a two-sheave block. A corresponding sheave block was anchored to the luffing winch foundation, and the 25½-ton pull required for lifting was applied by a 7-ton hand winch through five parts of rope. When the tackle just described was adjusted to take the strain, the cross channels on the

45ft. derrick poles were, of course, removed to allow the support to be raised. During the raising, the support was steadied by side guys, which were paid out as required during the lifting by 30-cwt. hand winches. After being raised to the vertical, the support was lowered with the aid of jacks into its socket. A view of one of the head supports in course of erection is shown in Fig. 2. The temporary guys for the supports were fastened to the permanent foundations, in which special anchorage ironwork had been provided for the purpose and to timber piles or deadmen, as convenient.

When the head support was erected the main back anchor cable, which consisted of two cables, 8in. circ.,

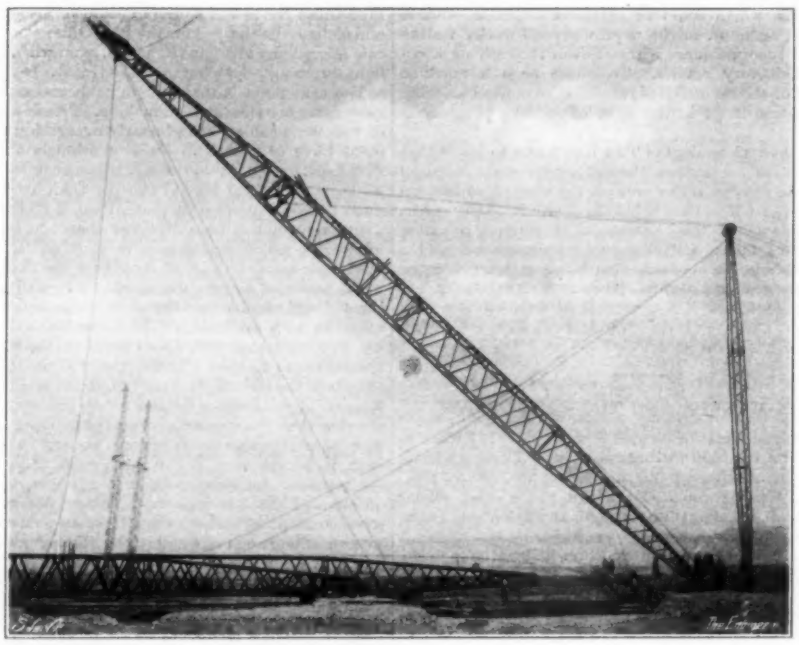

FIG. 2 ERECTING A HEAD SUPPORT

passing round a porting pulley connected by link plates to the main pin at the top of the support, was put into position and connected up. No adjustment in the length of this cable was provided, and the support was allowed to lean over a little until the pull of the main cable brought it to the vertical. To balance the considerable pull of the main back anchor before the main cable was erected, the support was anchored to timber piles driven in the river or to the steel piling for the lock walls which could conveniently be used for the later cableways.

The next step was to erect the main cable, which weighed over 17 tons. The cable was uncoiled from its drum at the head end, and the tail end of the cable was hauled across the river by a winch on the east bank. It was supported in the river on four or five barges. The sockets and crossheads had been fitted in position on the cables at the works before dispatch from this country, so that, after the cable had been threaded through the load carriage, the head end of the cable was raised and connected up with the permanent tension bolts to the main top pin at the top of the support. The tail end of the cable was then raised and hauled over the saddle at the top of the tail support, connected up by the link plates to the porting pulley and pulled up by the tackle provided to the required sag and tension.

The erection of the winding gears and operators' towers was straightforward work, and was completed in advance of the supports and ropes, so that, when the main cable was in position, it only remained to erect and tension the travelling rope and put up the button rope and hoisting rope to make the cableway ready for work.

Each mast is anchored to a single foundation in line with the main cable, and is mounted on a massive steel ball and socket pedestal, so that it can be moved or "luffed" out of the vertical to either side of the centre line. The object of this motion, which is controlled through side stays and tackle by powerful hand winches with special safety features, is to enable each cableway to command vertically a considerable strip of the barrage. The normal movement is 25ft. in each direction, so that each cableway commands a width of 50ft. A view showing one of the head supports luffed to 25ft. is given in Fig. 3. For special lifts the supports can be luffed to a greater angle, and, of course, loads can be picked up and placed over a wider range by pulling the hook out of the vertical, which it is comparatively easy to do, owing to the great height. It will thus be seen that the five machines effectively cover the whole width, 340ft., of the barrage. From the diagram it will be seen that the cableways are not evenly spaced, but that they are more closely concentrated at the higher part of the barrage where there is a greater weight of material to be dealt with.

The cableways are electrically driven, the power supply being direct current at 460/500 volts. Each machine has a separate independent winding gear—the positions of which will be seen in the diagram—with motions for hoisting and travelling operated by one motor of 125 B.H.P. through friction clutches. The hoisting speed with full load is 250ft. per minute, and the travelling speed 1250ft. per minute. All gears are machine cut, the first reduction being double helical. The hoisting and travelling drums are 7ft. 6in. diameter.

The hoisting and travelling ropes are led from the winding gear to a pulley frame at the base of the mast, and thence to pulleys at the masthead. The drum shafts, the hoisting and travelling rope pulleys and the trod wheels of the load carriage travelling on the main cable are fitted with ball and roller bearings. The travelling rope takes a half turn round the travelling drum, which is lined with beech blocks. Owing to the high tension in the travelling rope due to the great span, the half turn is ample to drive the travelling motion, and it has been found that no slipping takes place. The load is lifted on five parts of wire rope and a hoisting block with a swivel hook.

From the diagram and half-tone engravings, it will be seen that the winding gears are placed so that the operator gets a good perspective view of the area commanded by his machine, and to improve that view the operating platforms are mounted on steel towers about 40ft. above the winding gears. These platforms are seen in the view on page 288. As a further help to easy and rapid working, indicator gear of a type which Messrs. Henderson have fitted to a number of their cableways, is provided in the operator's cabin. This gear works as follows:—Gearing driven from the travelling and hoisting drums controls, respectively, the horizontal and vertical movement of a pointer, which moves to and fro and up and down across a scale, thus showing the position of the hook at any time. The normal sag of the cable is compensated for by means of a curved guide, and if a scale elevation of the works is mounted behind the pointer, the operator can pick up and

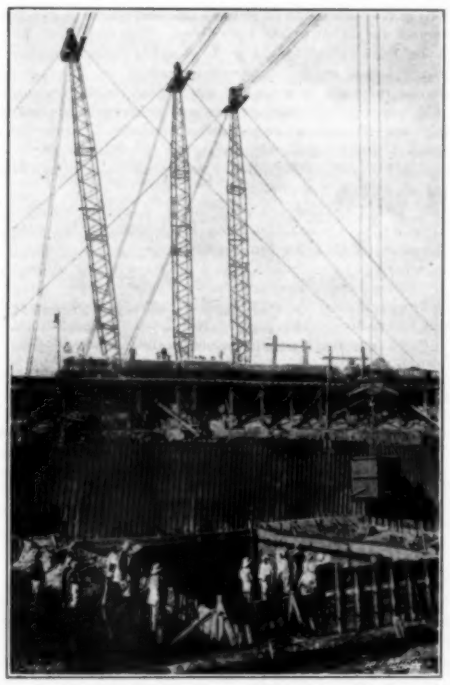

FIG. 3 HEAD SUPPORTS ONE LUFFED

place loads with reasonable accuracy without being able to see the points in question. Electric signalling apparatus is also supplied with these cableways, which enables an observer near the point where work is being carried on to convey to the driver any definite and precise instructions as to the movements required. We understand that for the first season's work, which is comparatively close to the winding gears, this signalling gear has not been brought into use.

Owing to the poor nature of the ground, it was found necessary to make very generous foundations, and to drive a considerable number of piles to take care of the heavy loads and pulls involved in these large machines; but apart from that, no difficulties were experienced in erecting and putting the cableways to work, the method of erection of the masts and ropes having been previously considered, and special tackle provided and sent out for the purpose.

The first work which the cableways were required to perform was the removal of the wet sand from the bed of the Nile by means of large tray skips, which, as soon as filled, are lifted, run to a dump and emptied, and returned to the site of the excavation. The dump is in the river outside the piling which protects the first season's working, and will be removed by the Nile waters when they rise in flood. Secondly, the cableways are being used for placing the concrete of the foundations of the barrage. Considerable use has also been made of them in unloading barges of sand, rubble, and dressed ashlar, and in placing the materials where required. They have, furthermore, been useful in transporting the sections, materials, and men to and from the east bank of the Nile, and have unloaded a considerable quantity of ashlar from wagons and placed it close to the cranes working on the masonry. Steel piles have been transferred from wagons to the pile frames, and on many occasions the pile frames themselves have been moved by the cableways, as well as other machinery, such as pumps and concrete mixers.

The erection and putting to work of these five very large cableways was, we are informed, carried out without a hitch of any kind, and without any appreciable interference with the traffic up and down the river. Very large quantities of materials have been handled by them during the first season's work, but they will be even busier and more useful during the coming season, which begins when the Nile Waters recede in the autumn.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

IS STATIC BALANCING OF ROTORS SUFFICIENT?

SIR,—The issues of THE ENGINEER, dated March 23rd and 30th, 1928, contain an article by Professor B. P. Haigh dealing with "The Static Balancing of Rotors," the purport of the article being that in the majority of cases static balancing in itself is quite sufficient, and that dynamic balancing, even in the case of drum-shaped bodies, is more or less superfluous. At the outset, Professor Haigh maintains that this problem is one which can only be solved by experience. He then endeavours to prove theoretically and on paper that which he agrees can only be decided in practice.

In Professor Haigh's statement, two conditions are mingled which really have no connection with each other, *i.e.*, the critical speed of the body with flexible shaft and the effect of unbalance on a practically rigid body. As Professor Haigh's argument conduces to confusion in the mind of the reader—in some measure to the detriment of British industry—a contradiction of his statement in respect of the following leading points is, I think, appropriate.

Modern balancing technique divides all bodies to be balanced into three classes:—

Class I. includes all bodies which may be regarded as practically rigid within the range of their working speed. These bodies are not subject to deformation through the action of centrifugal force, nor do they run through a critical bending speed. Experience has shown that the largest percentage of all rotors of the machine and electrical industry belong to this class. It is proved in practice that static balancing of these bodies is only efficient where the circumferential velocity is not more than 20 m. per second, and where the diameter of the body is at least six times greater than the width; in other words, where the body approaches disc shape. If these conditions are not fulfilled, the result of static balancing, even with the most sensitive appliances, is questionable from the beginning. Should the body be decidedly drum-shaped, it is quite possible that it will run worse after static balancing than before. The only efficient remedy is correct dynamic balancing, which can be effected at any desired speed—resonance speed about 500 r.p.m.

Class II. embraces constructively flexible rotors. The construction of these rotors being really faulty, various parts of the body displace themselves during running—for example, the windings of a turbo-generator—so that the partition of mass differs at each speed. Rotors such as these cannot be balanced statically at all. Perfect running in this case can only be achieved if the rotor is made constant at the working speed, and if the final balancing is carried out at this speed.

If a 3000 r.p.m. turbo-generator were balanced with the greatest possible care on the gravity scale recommended by Professor Haigh, far from running smoothly, there would be a real danger of disturbance and even breakage occurring.

Class III. includes all so-called flexible shaft rotors, characterised by the occurrence of a critical bending speed below their highest working speed. Such bodies undergo deformation at certain speeds on account of elastic bending oscillations of the shaft, thus producing oscillations in the body which can only be removed when the vibration of the shaft is removed. Bodies of this class are tested by a special dynamic process. A high-speed six-cylinder crank shaft, for instance, would be tested within the deformation zone at high speed for the purpose of dynamic "settling" by this special process. Afterwards the crank shaft would be balanced by the normal process at low speed in the same machine.

The partition of mass and form being constant at all speeds, these bodies do not show any noticeable oscillation after balancing, and behave similarly to those of

Class I. Cardan shafts, crank shafts for automobiles and aeroplanes, a certain percentage of centrifugal pump runners, some turbine runners, cutter shafts for flesh-removing machines, and textile machine parts with few exceptions, belong to this class of rotor.

After these general remarks, I should like to refer specially to certain points raised in the article in question.

Professor Haigh proposes to balance separately each wheel of a turbine runner, consisting of various wheels, and to proceed in such a way that each of the wheels one after the other is placed on the shaft, each time statically balancing the aggregate and fixing the compensation weight to the last wheel. The value of this proposal was tested in an experiment made ten years ago by a well-known firm of turbine manufacturers. This concern carefully overhauled their static balancing equipment, and, as described above, statically balanced a 5-ton turbine runner, the largest wheel of which was 2000 mm. in diameter. When the balance thus obtained was tested on a dynamic balancing machine—Lawaczeck-Heymann system—considerable unbalance was disclosed and compensated by two weights at the ends of the drum. These two balancing weights were axially displaced 90 deg. from each other, which proved that not only static, but also dynamic unbalance was present. Calculated on the circumference of the wheel, one of the compensating weights was 120 grammes and the other 400 grammes. The most sensitive static balancing apparatus could not have appreciably altered this result, which was the subject of considerable discussion in technical circles, and finally led to turbine manufacturers, in Great Britain as well as on the Continent, abandoning static for dynamic methods. It is interesting in this connection to note that the Dutch shipbuilding yard, De Schelde, of Vlissingen, where the gravity scale recommended by Professor Haigh had its origin, has for some years past balanced its turbines dynamically.

Professor Haigh further endeavours to prove that dynamic unbalance does not excite the testing body to oscillations when passing through the critical bending speed, whereas small static unbalance does interfere. It must be remembered, however, that the formula used by Professor Haigh, and according to which the amplitudes at the critical speed were determined—see Aug. Foeppl, Vol. IV., Vorlesungen ueber "Technische Mechanik"—is established expressly taking no account of dynamic unbalance. It is therefore not surprising that in using this formula Professor Haigh arrived at the conclusion that dynamic unbalance would have no influence on the critical speed. This deduction, to say the least, is untenable.

Following on this investigation, Professor Haigh draws particular attention to the question of dynamic unbalance, proving that static unbalance induces oscillations of the first order and dynamic unbalance oscillations of the second and considerably less detrimental order. Theoretically, this conclusion is correct. In practice, however, the fact must be reckoned with that the dynamic unbalance may also act as an exciting force of oscillations of the first order by reason of thrusts or concussions transmitted from the bearings or the frame. Such oscillations are neglected in theory, but these members are not absolutely rigid, and therefore in practice different conditions prevail.

Professor Haigh's contention further amounts to this, that elimination of static unbalance is of primary importance, whilst dynamic unbalance plays a secondary part, and he bases his proof on paper on the theory of the critical speed.

I would point out that a division of unbalance in static and dynamic unbalance is a theoretical abstraction as regards such a body as a steam turbine. The working conditions in reality are such that in each of the bearings shaking forces are produced, which rotate with the runner and which are active in any direction. These forces form a so-called force-cross or couple. Assuming that a turbine runner has been statically balanced with the Martin gravity scale, and that a residue of dynamic unbalance has remained, the forces released during rotation would act upon both bearings just as detrimentally as if they originated from static unbalance. The only difference would be that the shaking forces would act counter to each other at 180 deg. instead of at the resultant angle, if there existed also static unbalance. It is difficult to understand why the forces of dynamic unbalance should have less influence on bearings, frame and bed-plate than the forces arising from static unbalance of equal magnitude. Practical workshop experience has definitely confirmed in thousands of cases that static balancing is in no way sufficient. One case may be mentioned, that of a large fan-manufacturing concern, where a large percentage of the fans had to be rejected, as it was impossible in spite of the most careful static balancing to get them to run satisfactorily. After dynamic balancing, all the rejected fans could be used. Similar experiences have been communicated to me by a number of engineers in charge of balancing departments, and it is now common knowledge in practical circles that static balancing, however accurately carried out, is totally insufficient.

In cases where dynamic balancing tests are considered indispensable, Professor Haigh proposes separating the static and dynamic balancing processes. Such separation must be rejected on practical as well as theoretical grounds. Assuming that perfect static balance has been obtained by the Martin gravity scale, it would be essential that the compensation weights for the dynamic post balancing should form a clean couple. They would need to be exactly opposite each other at 180 deg., and the sum of weight and radius would need to be exactly the same. If this condition were neglected, a fresh static unbalance would be created. Similarly, it can be demonstrated that an artificial dynamic unbalance is created by static balancing, that is, if the balancing weights are not fixed in such a manner that their resultant passes through the point of gravity of the testing body. Such a system would be uneconomical and inaccurate. The practical balancing machine must be capable of eliminating all reaction of forces arising under working conditions.

The dynamic balancing machine reproduced in illustration, Fig. 7, of Professor Haigh's article is a machine which was in operation twenty years ago, but which to-day is hopelessly obsolete. I agree with Professor Haigh in his remarks that with such a machine the balancing is extremely cumbersome, and requires a great deal of time and expert knowledge. A steam turbine runner, weighing several tons, which could be balanced on an up-to-date machine in an hour, might require several weeks' testing on the old-type machine, without even then giving absolutely satisfactory results. To quote such a machine as a proof of the necessity of returning to static balancing appears to me inept in the light of modern progress in this field.

It may interest readers of THE ENGINEER to know that neither the fully described Martin gravity scale, nor any other of the gravity scales now on the market, represents a new idea. In 1904 Carl Schenck, G.m.b.H., Darmstadt, manufacturers of the Lawaczeck-Heymann dynamic balancing machines, had already constructed and sold a similar machine, this construction being withdrawn when the full significance and importance of dynamic balancing was appreciated.

HANS HEYMANN, Dr.-Ing.

Darmstadt, August 23rd.

CABLE MAKERS AND THE POST OFFICE.

SIR,—In your issue of August 31st on page 217 there is a heading "A Contract for Bronze Wire." There is a little confusion in relation to this matter as set out by you. About two-thirds through the note it states the "official explanation," &c., and then mentions the Telephone Cable Manufacturers' Association.

The particular contract in question had nothing to do with the Telephone Cable Manufacturers' Association in any shape or form.

An Advisory Committee on the Post Office Estimates recently made reports, both as to the price of bronze wire and as to the prices of telephone cables, in both cases stating that "Associations" or, as they call them, "rings" were in existence.

The explanations given in the early part of your article are those given by the wire-drawing firms in relation to the particular contract which has been given abroad.

With regard to the suggestion that because there is a Telephone Manufacturers' Association the Post Office are charged excessive prices, considerable publicity was given to this by the Press. I enclose you herewith copy of a statement I made and which was circulated to practically the whole of the British daily Press, but only two papers, as far as I know, published this statement. To this statement I will, however, add only one thing more, and that is, that notwithstanding all the implications of the report, there is no statement in it that the Government has been charged excessive prices for cables. The objection taken by the Post Office to the wish of cable manufacturers in certain cases to fight dumping prices in foreign and colonial markets is seriously damaging British manufacturers' prestige in these markets, and everybody acquainted with export business is aware that at times it is absolutely necessary for British manufacturers to meet foreign competition by quoting even below cost price to maintain their hold on certain markets.

THE CABLE MANUFACTURERS' ASSOCIATION,
LLEWELYN B. ATKINSON, Director.

London, W.C. 2, September 6th.

STATEMENT BY MR. LL. B. ATKINSON.

I have not seen the report, as it does not appear to have been available to the public, but from the statement in the Press I gather that the report in effect states:—

(1) There is a "ring" in the telephone cable industry.
(2) There are only two firms not in this "ring."
(3) That British cable makers quote lower prices to the British Empire Overseas and to the Irish Free State.
(4) That telephone cables will be delivered in England by continental manufacturers cheaper than they can be bought from British cable manufacturers.
(5) The manufacturers will not allow the P.O. to examine their books, and draws the conclusion, therefore, that the Post Office are being charged unreasonable prices by the cable makers in the "ring."

The conclusion may appear logical, but is not, because important additional facts were either known and suppressed, or if not known, might have been, if among the evidence taken had been evidence from any manufacturer.

Taking these points in order, the report speaks as if they have made a great discovery as to the existence of a "ring." The fact is that for nearly thirty years the Cable Makers' Association has existed and every interested person has known of its existence. During the whole of that period the members of this Association have sold their standard cables at the same prices, and ever since the Post Office took over the telephones it has known of the existence of such an Association, and has taken steps to be satisfied that the prices are reasonable. In 1921 the Government "Profiteering Committee" examined into and reported on the proceedings of the Cable Makers' Association, and specifically examined and reported upon the relations between the Post Office and the manufacturers in the Association. It reported to the effect that it could find no evidence from any source that the Association were acting unreasonably in their prices or otherwise, and went on to say that the operations of the Association had been highly advantageous to the industry and to the users of their goods. This Committee, unlike the present one, heard both sides. The statement that British cable makers quote lower prices to the British Empire market overseas and to the Irish Free State is not as a general statement true. They would like to do so at times of slack employment; they could employ more British labour if they did so, it would help them to reduce their costs on the home market production if they did so. They have been urged by the Department of Overseas Trade to meet the competition abroad, but they cannot because the British Post Office has stated to the makers that they will expect and claim to be charged for the Post Office work the lowest rate offered anywhere in the world, even when it is done to fight dumping prices from the Continent.

The next point is that foreign cable makers will deliver cables cheaper than British makers. This is true, not only of telephone cables, but of nearly everything the Government buys or makes in its own arsenals and factories. Warships, aeroplanes, printing, stationery, &c. &c., could all be bought from abroad cheaper than from home producers, and for various reasons. First of all they would be a surplus dumped here at lower than the home market price; second, it would be a great advertisement in the world market to be able to show that the British Government preferred continental goods to British goods; but thirdly, and most important of all, continental makers can afford to do it profitably. The Cable Makers' Association has publicly issued statements based on the reports of the International Labour Bureau, Geneva, on the published reports of the British Ministry of Labour, and on the recent Reports of the Balfour Committee on Industry and Trade, showing that the wages and standard of living in the industries, of which cable making is one, are as an average 35 per cent. to 40 per cent. below those existing in the British cable trade. So this question is not one on which the question of the Association or "ring" has any bearing; these continental makers are also in associations or rings. The question is one of whether the State should buy goods made on a lower standard of living than the British. If as a matter of general policy it decides to do so, then the issue is clear and wages and conditions here must be graded down to the continental level.

The last charge is that the telephone cable manufacturers will not allow the Post Office to see their books. This is almost a joke. Why should they? If the Post Office agreed to buy all their requirements at a fixed rate of profit on cost it would be right to ask that they should do so. The Post Office is always itself a potential competitor. They have frequently been pressed for political reasons to establish a factory to make their own cables, and can it be contended that the existing manufacturers should help them to do so by giving them access to all the knowledge and information that they have acquired at great cost to themselves?

The British Cable Makers' Association after thirty years of existence stands to-day as a model of what a rational organisation of an industry can achieve. It has built up a reputation for British cables which makes them the world's standard of quality. It has a larger export sale of cables than any other country in the world. The works are absolutely up to date, the industry is prosperous. The relations between employers and employed are excellent, working through a Whitley Joint Industrial Council which has been stated to be the most successful in existence. The wages paid are higher than in allied industries employing the same class of skill. The Association has taken a prominent part in standardisation and research in the electrical industry. It was recognised by the State Departments during the war as the organisation which it consulted and used for important purposes; only recently it has been consulted by and thanked by one of the State Departments for the valuable assistance it has rendered in a difficult technical investigation.

At a time when all parties are seeking to diminish unemployment, I cannot believe, in the absence of a single word of proof of overcharging, that the policy of equipping a State service with foreign material will be tolerated.

THE up night Irish mail on the morning of February 29th last ran into the buffer stops at Euston with such force that the body of the third coach from the engine was partially lifted off the underframe and the gangways of the second and third coaches were forced in and the end rails damaged. Those three coaches were Post Office vehicles and fourteen of the Post Office staff suffered from minor injuries or shock. The buffer stops are of the hydraulic and compressed air type, with a travel of 2ft.; they were undamaged. The accident was inquired into by Colonel French, whose report thereon has recently been issued. There is a speed limit of 10 miles per hour for entering the station. The driver maintained that he was not running at more than 8 miles per hour, but that some little way down the platform he thought he was slowing too much, so released the brake a trifle; after that he realised that he was going too fast, but could not pull up in time. As stated in this column of our issue of August 31st, in connection with a further buffer stop collision on August 27th, the curvature of the line in Nos. 1 and 2 platforms—the roads concerned in these two accidents—gives a driver a rather short view of the buffer stops. Colonel French thinks that the driver misjudged his speed and, in view of the second accident on August 27th, it may be noted that he added that care is required on entering this platform in view of the limited vision on the curve. Provided the existing speed restriction is strictly observed, and proper caution exercised by drivers, he does not see that any further measures are necessary.

Railway Matters.

THE retirement, on entering his seventieth year, is announced of Mr. Thomas Powell, the secretary and general manager of the Pullman Car Company. He is being succeeded in the general managership by Mr. G. H. Griffith, who has been connected with the Egyptian State Railways since 1902, latterly as deputy general manager.

MENTION was made in our annual article of January 13th last on Railway Engineering in 1927 of the new oil jetty that the London and North-Eastern Railway was constructing at Salt End, Hull. The jetty is now completed. It is 1900ft. long and has a T-head 300ft. long and doubles the accommodation for discharging oil cargoes and 700,000 tons of oil per annum can now be handled.

A CORRESPONDENT complained recently in *The Times* that he had sent his luggage as parcels, and that the weight of 81 lb. had cost him 9s. 2d. Mr. Arthurton, of the Railway Information Bureau, replied by pointing out that a third-class passenger is entitled to take 100 lb. of luggage with him free, or he can have it collected, conveyed, and delivered free for 2s. Mr. Arthurton suggests that the complainant made his journey by motor coach, and that therefore the conveyance of his luggage at parcels rate was a reasonable charge. It is rarely that the companies have an opportunity for so neat a retort.

IN reporting on an accident to a lad who was oiling the machinery of a traverser, owing to the traverser suddenly moving owing to some foreign substance getting between the valve of the stationary hydraulic engine and its seating, Mr. J. L. Moore, one of the Assistant Inspecting Officers, draws attention to the fact that the machinery in question was not examined at any stated period. No records are kept of any inspections or repairs. In view of the fact that the oiling and working of these traversers is left entirely to young and inexperienced lads, something more definite in the way of examination by the technical staff would appear to be desirable.

THE Ministry of Transport census of the number of persons employed by British railways during the week ended March 10th last and the corresponding figures for the week ended April 30th, 1927, show that 677,148 persons were employed as compared with 683,077 in 1927. Of the former figure 618,882 were males engaged on the railway proper; 34,406 were males in ancillary businesses; 17,787 were females on the railway and 6073 in the other businesses. The four grouped companies employed the following:—London, Midland and Scottish, 262,878; London and North-Eastern, 200,517; Great Western, 110,591; and Southern, 73,005. Next to 116,617 shop and artisan staff and 74,115 officers and clerical staff there come:—Permanent way men, 64,289; drivers and motormen, 37,546; firemen, 35,427; labourers, 29,131; signalmen, 28,195; passenger porters, 26,119.

THE winter train service comes into force on September 24th, when considerable modifications will be made in the excellent facilities provided since July 9th. The "Royal Scot" of the London, Midland and Scottish will no longer run non-stop between Euston and Carlisle, but will call at Rugby and Crewe; and the "Flying Scotsman" of the London and North-Eastern, which has been making no call in the 400 or so miles between King's Cross and Edinburgh, will call at Grantham, York, Newcastle, and Berwick. The engines will continue to work the whole distance throughout, but the enginemen will be changed at Newcastle. The Cornish Riviera Express of the Great Western will call at Exeter. That is more than a reversion to winter timing, as for nearly twenty-five years the train has run non-stop to North-road, Plymouth, and slipped a carriage at Exeter. The run to Plymouth is again to be 4 h. 7 min. instead of the level 4 h.

THE Ministry of Transport has issued through the Stationery Office, price one shilling, a new edition of what, until the Ministry was established, was known as the Board of Trade Requirements for New Railways. The main changes effected in the previous edition—of February, 1925—appear to be in respect of colour light signals; the operation of points by wire instead of by rodding; the provision of a track circuit instead of a locking bar for holding facing points; wheels guards for important bridges and viaducts—as indicated in this column on February 17th last—warning boards at public road level crossings where gates are not provided, one to be visible by night as well as by day; and, whilst the requirement as to refuges for men working in tunnels remains unaltered, it is amended in respect of long viaducts, vertical cuttings and retaining walls, in that such may not be necessary where clearance, allowing for suitable standing room, of not less than 5ft. from the outer edge of the running rail is available.

THE electrification of the Manchester, South Junction and Altrincham Railway—locally known as the "South Junction"—mentioned in our Seven-day Journal on September 7th, has features of interest beyond the important fact that the work is ordered. There is, for instance, the ownership of the line. It was originally jointly owned by the Great Central and London and North-Western, but whilst it now belongs to the London and North-Eastern and the London, Midland and Scottish, it is independent of the Cheshire Lines Committee, which joins it at two places and which is also owned by the L. and N.E. and L.M. and S. Moreover, it has its own local officers. Another point is that this work has been ordered before the Manchester and Oldham electrification, which has been much longer under discussion. That is probably accounted for by the development of the city of Manchester in a southerly direction and the desire to provide for the necessary additional transport before the Manchester Corporation omnibuses and trams get a firm hold. An outstanding feature is that the trains will probably be operated by electric locomotives. If that be so, it will be the first example in this country, for passenger train working, outside the Metropolitan Railway, and when the overhead construction is removed off the Brighton section of the Southern Railway early next year the M.S.J. and A. will be the only passenger line with it except the experimental lines of Bury-Holcombe Brook and Lancaster-Morecambe-Heysham. The Newport-Shildon overhead operation is for goods only. It is of interest that the South Junction, being jointly owned, will be an object lesson for two companies.

Notes and Memoranda.

IT is expected that the output of the new Mashaba asbestos mine, Southern Rhodesia, will be at least 100 tons a month.

ACCORDING to Mr. Norman Gibson, chief engineer of the Niagara Falls Power Company, more than double the present power development may be obtained at Niagara Falls without impairing their beauty.

FOLLOWING numerous tests, with satisfactory results, steel plates, containing 0·28 per cent. copper, are to be used in the construction of two vessels at the shipyard of the Deschimag A.G. at Bremen. Tests made are said to have shown that the higher cost of these copper-bearing plates was offset by their extended wearing qualities through resistance to corrosion.

ACCORDING to official statements "only 43 per cent. of the area of the United States is typographically mapped, and half the existing maps fail to meet present-day standards of accuracy." Interpreted literally, therefore, 78·5 per cent. of the area of the country is without the data necessary to carry on in an economical manner engineering projects of extensive character.

IN the summary of the latest publication of the Safety in Mines Research Board, obtainable from H.M. Stationary Office, price 6d., which deals with Spontaneous Electrification in Dust Clouds, it is recorded that electricity is generated in coal dust clouds raised by a current of air; that the quantity generated increases with the speed of the air current and with the weight of dust used; that the quantity varies with the particular sample of coal dust; and that sparks may be obtained from the charges so generated.

A JAPANESE investigator, Mr. M. Imatomi, has, according to the *Iron and Coal Trades Review*, carried out some experiments of producing cementation of electrolytic iron with a mixture of benzol and nitrogen at temperatures up to 850 deg. By passing a current of the mixture over the incandescent iron at the rate of 1000 cubic cm. per hour for 1, 2 and 3 hours respectively, he increased the weight of the specimen by 1·7 per cent., 2·4 per cent., and 3·2 per cent. respectively. He claims to have produced by this means iron so hard that it scratched glass.

THE establishment of the Holland Institute of Thermology, to conduct researches into various phases of the relation of humidity, temperature and circulation of air to public welfare, has been announced by Mr. A. H. Landwehr, President of the Holland Furnace Company of Holland, Mich., U.S.A. It will attempt to solve some of the heating and ventilating problems of industry, study the effect of humidity upon various industrial products used in houses, and investigate problems connected with industrial housing and the efficiency and working conditions of workers in shops and offices.

IN commenting on American activities in the way of broadcasting moving pictures, *Nature* says:—To suggest that the radiovision pictures are anything like so good as sound radio broadcasting was in 1921, is scarcely fair to the many able engineers engaged on the problem, and discounts the advances they will doubtless make in the future. The pictures are still very crude, and no doubt many difficulties have still to be overcome before any radiovision service can be considered satisfactory, but every encouragement should be given to those who are devising even slight improvements of existing apparatus or methods.

SOME experiments for the purpose of generating steam from high-pressure current (50,000 to 80,000 volts) that may open the possibility of utilising the surplus energy of waterfalls to good advantage are being carried on under the auspices of the Swedish Institute of Industrial and Engineering Research, according to a report just published in *Swedish Export*, the organ of the General Export Association of Sweden. It is reported that the trials so far carried out have yielded most interesting results. The electric boilers now in use cannot use a higher tension than 30,000 volts, but if the costly transformation from the customary transmission line voltage can be avoided, this mode of generating steam will prove remarkably cheap. Pulp mills, which are very large consumers of steam, would in many cases benefit by the proposed arrangement.

FOR many years in all circuits entering stations it has been customary to provide choke coils on the station side of the lightning arresters, for protecting the terminal equipment against line surges. Until recently, however, nobody seems to have taken sufficient interest to investigate just how much protection such choke coils actually furnish. In a recent report of a surge recorder investigation it was brought out that six out of ten surges recorded, produced a lower voltage on the station side of the choke coil than on the line side, whereas four surges produced a higher voltage. The preponderance of this evidence is on the side of using choke coils, but the four cases of higher voltage indicate that there may be other cases where choke coils will do more harm than good. Further investigations by means of surge recorders would be of great interest.

A 500 kilovolt testing plant has been installed by the A.E.G. at the Enfield Cable Works, Brimsdown. Unlike other firms, the A.E.G. produces the high pressure by a single transformer erected in a plain boiler plate tank filled with oil. This tank is, of course, earthed, so there is no danger to the operator. In view of the large charging current taken by the cables during test, it was necessary to have a large continuous output. The transformer can supply at 450 kV single-phase of 260 kV three-phase continuously. The maximum pressure is only to be applied for five minutes. The spark gap is between two spheres each of 75 cm. diameter placed horizontally. The length of the spark gap is adjusted electrically by means of a motor driving a worm shaft. The maximum distance apart of the two spheres is 50 cm., and it takes four minutes before the spheres touch one another. The exact distance between the spheres is read by both mechanical and electrical indicating devices. The voltage can also be measured by means of an electrostatic voltmeter shunting the two condenser plates which are nearest the earth of a chain of condenser plates. Very elaborate safety devices and interlocks are employed.

Miscellanea.

IT is proposed to erect a large beet sugar factory at Sarnia, Ontario.

A NEW main of anthracite coal 11ft. or more thick has been discovered near Banff, Alberta.

A DEPOSIT of osmiridium has been discovered in the Valley of Rasselas, Gordon River, Tasmania.

THE plant at the new gold mines of Luiri Gold Areas, Ltd., in Northern Rhodesia, is about ready for production.

A NEW six mill tin-plate works is to be erected at Gurnos, near Ystalyfera (Swansea Valley). Work is to be started at once.

AN electricity supply scheme, which is to cost 15 lakhs of rupees, is to be provided for Bareilly, United Provinces of Agra and Oudh.

A COMPANY has been formed in Rhodesia to develop some asbestos deposits in the Belfast district, some four or five miles east of Dullstroom.

THE City Council of Ottawa proposes to expend 1,315,000 dollars on a rapid filtration plant to supply the city with 34 million gallons of water a day.

OVER 1000 tons of fine tool steel entered France during the first quarter of 1928, whereas imports for the corresponding period of 1927 totalled only 280 tons.

THE city authorities of Saskatoon, Canada, invite tenders for a 10,000 kW steam turbine alternator, condenser and auxiliary equipment, or alternatively one 7500 unit.

ACCORDING to official statistics there are at present 73 motor trucks, 58 motor cycles and 745 motor cars running on the streets of Canton. The municipality is paying great attention to the roads and has adopted strict rules for regulating traffic.

THE Chinese Government has decided to install a powerful wireless station in Shanghai, with branch stations in Yunnan Province, Sian, Shensi Province, Hankow, Nanking, Canton, and Sinkiang. The plan is said to be on a large scale, but details as to machinery and equipment are not yet available.

BOTH Krupp's and the United Steel Works have, says the *Ironmonger*, revived the Talbot steel process in certain of their plants. This process was abandoned in Germany about twenty-five years ago, but it seems that certain improvements have been introduced, and there is now a possibility that it may supersede Thomas steel.

IT appears that the Rhodesian Broken Hill Company contemplates getting an additional supply of power from the Victoria Falls of the Zambesi. For the present, however, it is suggested to raise the dam at Mulungushi by 12ft. and install a 6000 kW turbine, while an adjacent river may be utilised to provide another 15,000 kW.

THE city authorities of Sydney, Nova Scotia, have asked the Dominion Coal Company to make an estimate of costs, and to submit figures, for supplying Sydney with electric light, heat and power, from a huge new power plant, which the company contemplates constructing in the near future, somewhere between Sydney and New Waterford, to generate the whole, or part, of its own southern colliery power requirements, which total about 100,000,000 kWH a year. According to unofficial reports, the plant will burn powdered coal.

A SCHEME has been put into operation by the New York Edison Company for supplying consumers with battery charging plant for electric vehicles on the instalment plan. Under the scheme the consumer can select the kind of charging board and equipment desired, and it is installed under the direction of the engineers of the New York Edison Company, payment being made in twelve monthly instalments along with the monthly remittance on the company's bill for electrical energy. No interest or other charges are made, simply the cost of the equipment.

THE Minister of Transport announces, in connection with the World Motor Transport Congress to be held in Rome from September 25th to 29th, the British Government will be represented by the following who have been appointed by the departments named:—Ministry of Transport, Lieut.-Colonel C. H. Bressey, C.B.E.; W. J. Hadfield, M. Inst. C.E., City Engineer of Sheffield; G. J. Shave, M.I.M.E., M.I.A.E., chief engineer and operating manager of the London General Omnibus Company. War Office, Major C. H. Kuhns, D.S.O., C.B.E., A.M.I. Mech. E., Royal Army Ordnance Corps. Department of Overseas Trade, Dr. H. C. A. Carpenter, commercial secretary, British Embassy, Rome.

THE reliability of the marine oil engine of the Burmeister and Wain type would seem to be attested by the motor vessel "Bianca," which recently completed a round-world voyage with her engines running continuously. The record is not a new one, since we understand that the motor vessel "Siljestad," after completing her trials on September 5th, 1927, sailed from the Copenhagen Yard of Burmeister and Wain, Ltd., *vid* Antwerp to the Mexican Gulf, through the Panama Canal to Japan *vid* San Pedro. She then visited Shanghai and Vladivostock, and returning by the Dutch East Indies to Aarhus in Denmark, completed her round-the-world voyage in six months. The whole voyage was made without a single engine stop, and the same vessel has completed a second world voyage also made with her engines running continuously.

THE Austrian Parliament has just passed a Bill freeing from all taxes for a period of ten to twenty years establishments producing and distributing electricity, the exact period, which will not be less than ten years, to be fixed by the Government in each case. The works to receive this privilege will be those with a minimum capacity of 5000 H.P., whose construction was begun between January 1st, 1927, and December 31st, 1931, on condition that they use material and equipment entirely of Austrian origin (except when the home industry does not produce the goods required or asks excessive prices), and deliver to third parties at least 55 per cent. of the energy they produce. In this way the Government hopes to stimulate activity in the industries which specialise in the supply of electrical equipment and to help the circulation of current in the country.

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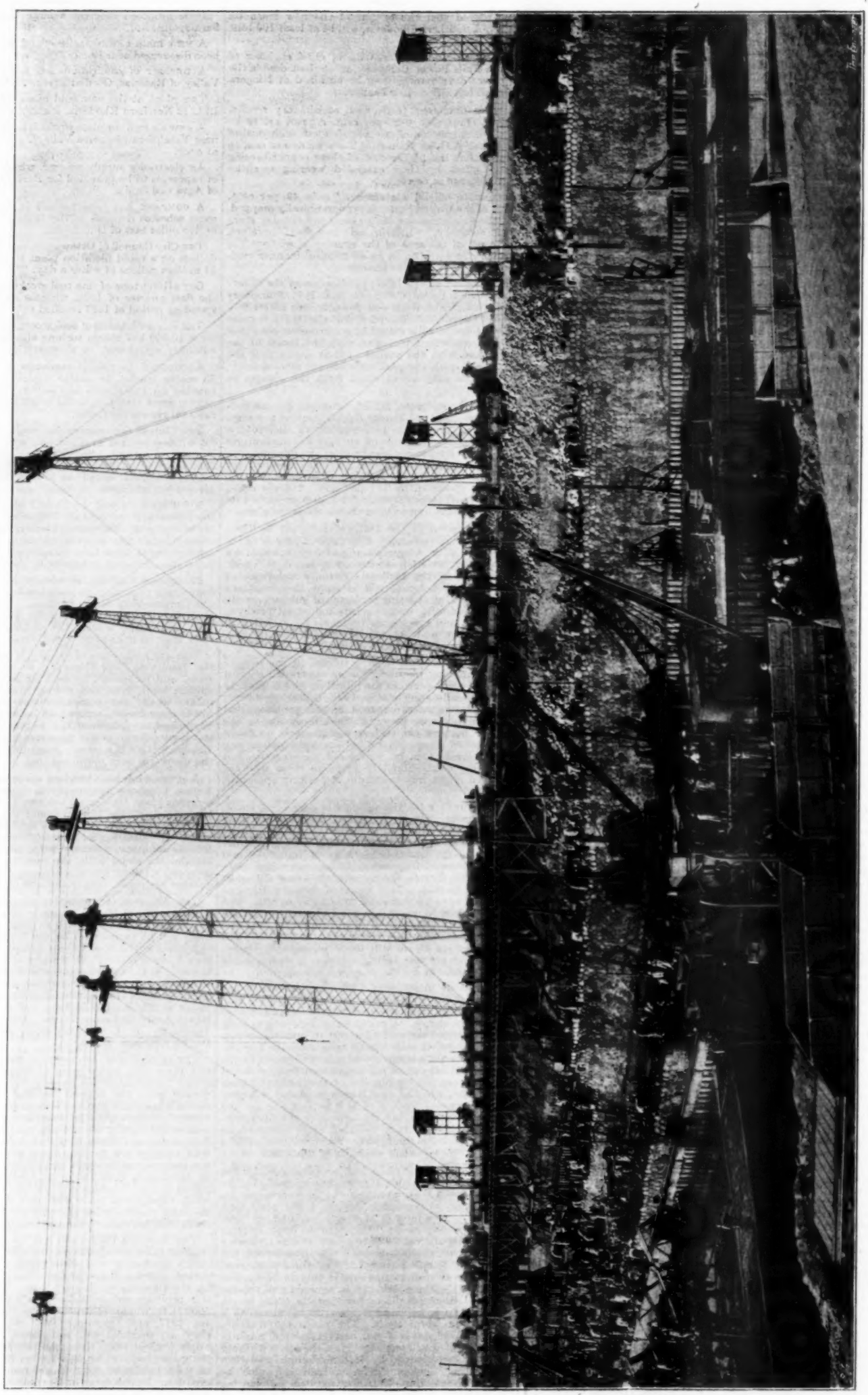

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Contents.

THE ENGINEER, September 14th, 1928. PAGE

A SEVEN-DAY JOURNAL .. 273
MACHINE TOOL EXHIBITION, OLYMPIA. No. II. (Illus.) .. 274
A NEW BRITISH CHEMICAL STANDARD ALUMINIUM ALLOY .. 280
THE INSTITUTE OF METALS. No. II. .. 281
CABLEWAYS FOR THE NAG HAMMADI DAM. (Illus.) .. 284
LETTERS TO THE EDITOR—
Is Static Balancing of Rotors Enough ? .. 285
Cable Makers and the Post Office .. 286
RAILWAY MATTERS .. 287
NOTES AND MEMORANDA .. 287
MISCELLANEA .. 287
LEADING ARTICLES—
The British Association .. 289
Built-up Electrical Machines .. 290
LITERATURE .. 290
SHORT NOTICES .. 290
BOOKS RECEIVED .. 290
SIXTY YEARS AGO .. 290
THE BRITISH ASSOCIATION—SECTION G : ENGINEERING .. 291
THE CENTRAL SCOTLAND ELECTRICITY SCHEME. (Illus.) .. 293
AMERICAN ENGINEERING NEWS .. 293
THE DIESEL-ELECTRIC OIL TANKER BRUNSWICK. No. II. (Illus.) 294
THE INFLUENCE OF ENGINEERING ON CIVILISATION (B.A. SECTION G ADDRESS) .. 297
A SUMMER SCHOOL OF ENGINEERING .. 298
AMERICAN SHIPPING POLICY .. 299
LAUNCHES AND TRIAL TRIPS .. 299
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 299
Lancashire .. 299
Sheffield .. 300
North of England .. 300
Scotland .. 301
Wales and Adjoining Counties .. 301
EDUCATIONAL INTELLIGENCE .. 301
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 301
CATALOGUES .. 301
CURRENT PRICES FOR METALS AND FUELS .. 302
FRENCH ENGINEERING NOTES .. 303
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 303
FORTHCOMING ENGAGEMENTS .. 304
PARAGRAPHS—
The Junior Institution of Engineers .. 304
Lloyd's Register Scholarships .. 304

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THE ENGINEER.

SEPTEMBER 14, 1928.

The British Association.

THE annual meetings of the British Association are readily differentiated from all other meetings by two characteristics. The advantages of life in a great university are that it enables contact to be made with thinkers who are working in a variety of fields. The student in engineering, if he is wise, attends lectures on subjects which have nothing to do directly with engineering; the student in divinity may expand his mind, if not by attending lectures which he fears he would be unable to understand, at any rate by listening to the conversation of physicists, biologists and engineers. Thus the university gives opportunities for the expansion of the intellect which no teaching institution with specialised objects can offer. The meetings of the British Association have a similar nature. Indeed, we might almost say that they represent annually an epitome of all that all the chairs in all the universities, all the seats of learning, have been debating in the preceding twelve months. It is, of course, impossible for any one man—even with the advantages of concentration in a single building as in Glasgow this year—to attend more than a few of the sectional meetings. But he may, if he will, hear all the presidential addresses, and he will, if he wishes to win from the meetings all that they have to offer, learn much by conversation with men whose line of thought is very different from his own. That is the first, most obvious, and most valuable of the characteristics of the British Association. The second is that all the presidential addresses and some of the sectional papers are presented in a form and manner which, for the sake of brevity, may be called "popular," for it is recognised that in the long run all knowledge is only valuable if it increases the happiness and contentment of the world at large and that, therefore, it is of direct interest to all men and women. The science which secludes itself, either by the use of a peculiar jargon or by the indifference or superciliousness of its followers, plays the world false. It deprives it of something that it should know, something of which it may be able to make use, or which may bring to it comfort and ease. It is one of the great merits of the British Association that its meetings are regularly used by the great thinkers of the day to lay before the ordinary men and women who make up the bulk of society the most recent advances in knowledge and thought.

In his presidential address Sir William Bragg recalled that the founders laid especial stress upon one purpose of the Association. It was "to obtain more general attention for the objects of science." The "objects" of science we take to be the progress of humanity towards a higher condition. Knowledge, any more than art, can never be its own end. "Science for Science's sake" and "Art for Art's sake" are alike selfish and futile. If science does not make for some high object—it may be, as in the case of astronomy, for the elevation of man's mind, or, in the case of engineering, for the convenience and comfort of his body—then it is worthless to pursue it. Men would be better employed in degrading their minds to the level of a cabbage, at which there could be neither suffering nor enjoyment, than seeking to raise it through inevitable pain and tribulation and the sensitiveness to pleasure and suffering which accompanies development. We must believe that, though increase of knowledge is increase of sorrow, it is also increase of happiness; that is to say, that through it we lengthen the scale of human sensibility at both ends. We must, whether we be scientists or just "ordinary Christians," stoutly hold with Sir William Bragg that "in some way which he—the student of science—cannot fully comprehend it is all worth while, and that every straining to understand his surroundings is right and good; and further, that in that way he can learn to be of use to his fellow-men." It is difficult for the scientist to keep this high ideal before him; it is still more difficult for the non-scientist to believe in its existence. Before science can become directly beneficial to the man in the street it has to pass, often enough, through devious and doubtful paths. The company promoter handles it, the inventor and patentee grabs at it, the capitalist invests money in it. At every stage it is, with relatively rare exceptions, made the source of gain before the public may have the enjoyment of it. Even the scientist claims that the labourer is worthy of his hire and secures to himself, if he can, a liberal advantage. There are not many Faradays nowadays; not many men whose devotion to science is such that they will not sell it. Few indeed are the research workers in the world who do not hope for a solid advantage from their investigations. The great research laboratories, with few exceptions, are carried on for the purpose of developing industries. Technical research is never defended or advocated on the ground that it increases knowledge, but always because, directly or indirectly, it will promote trade. There are some who affect to despise applicable science on that account; who assert, in Sir William Bragg's words, that "uselessness in science is a virtue." They are those who resolutely refuse to accept the world as it is; they will not recognise that no good reaches man save through some evil, some sweat and pains, some courses that are lower than the best. It is more philosophical to look upon the steps by which science is made available for increasing the happiness and comfort of man as equivalent to the intermediate processes in a chemical reaction which change a useless product into a valuable one. We cannot have *paté de foie gras* without fattening geese; we cannot enjoy the advantages of science without fattening industry and trade.

Whilst the existence of scientists of the kind to which Sir William alluded who despise all useful science cannot be denied, the tendency at the present day is unquestionably in the opposite direction. There is, indeed, a danger that it may go too far and that all knowledge which is not directly utilitarian may be neglected. A movement of that kind in education has been observable for years past, and the revival of interest in what may be described as intellectual studies is of very recent date. Indeed it only makes progress through the conviction that "there is money in it." In that respect, too, the British Association fulfils a valuable duty. Through its meetings and through the lengthy reports of them which appear in the daily Press it gives the public a general conspectus of the advance of knowledge in all branches. That is much to the good; on the one hand, because it leads towards the enlargement of the mind, and on the other, as far at least as the scientific sections are concerned, because it engenders an understanding and appreciation of science. Advantage cannot be taken of the great work that is being done by scientific investigators, the public cannot secure the amenities to which science may lead it, as long

as it is not in sympathy with the work of scientists and is unprepared to help and encourage them. By laying before the world, through the mouths of those who are best fitted to speak, accounts of the development of science and scientific methods, the British Association does much to help scientists to be of use to their fellow-men.

Built-up Electrical Machines.

JUDGING from what is taking place in some of the large electrical works in this country, in America, and elsewhere, the pattern shops and foundries of electrical concerns will soon, if they are not already, be short of work. Whereas a few years ago it was the usual custom to cast stator frames, bed-plates and other parts of electrical machines, the tendency is now to utilise welded mild steel plates. By making large structures of these plates instead of casting them in the ordinary way material advantages are gained. The structures are lighter and are much less liable to damage during transit; no expensive patterns are required; the large space needed for storing them is saved, and so far as electrical work is concerned it is unnecessary to maintain an extensive foundry. The idea of building up large and massive parts of electrical machines is not new, but for some reason the scheme has only recently attracted the attention of the leading British electrical firms. Although it is probably generally believed that the idea originated in America, records seem to show that the first fabricated machines were made in Germany. The fact remains that American firms have carried out a large amount of work of this nature. In 1924 the American General Electric Company made a 1400 kVA machine with a stator composed of steel plates, with the outside wrapper plates, foot-plates, and ribs for retaining the stator punchings hand welded in place. It proved to be lighter than a similar cast machine, whilst deflection tests showed that it was stronger. The reduced risk of breakage was an advantage that appealed strongly to the makers.

Since this machine was made practically all the stator frames made in the American General Electric Company's works have been built on this fabrication principle. The method of manufacture has now been taken up by several of the large electrical firms in this country, and there seems to be every prospect of the practice of casting massive structures for electrical work dying out. Welding firms are alive to the possibilities which the change presents, and some are preparing to carry out work of this nature for the smaller electrical firms which do not possess the equipment or experience necessary to enable them to undertake the work themselves. While little or nothing has been written on the subject in this country, in American technical publications interesting information concerning built-up electrical machines is to be found. In the March issue of the *Journal* of the American Institute of Electrical Engineers Mr. A. P. Wood, of the American General Electric Company, throws a good deal of light on what has been done by that concern. Arc welded steel plate machines as large as 40ft. in diameter for slow speeds and as high as 10ft. for high speeds, and up to 100,000 kVA have been constructed. Very extensive tests have been made on samples of plates joined together with single, double, and triple-layer welding carried out by hand and automatically, so that there is now no question about the kind of welding to be employed for any particular design. Wherever possible hand welding has been superseded by automatic welding. On large-diameter stators two or more circular frames made up of segments are welded together by a semi-automatic system involving the use of a hydrogen-enveloped arc which results in a ductile weld that is easy to machine or grind and which will not break if accidentally stressed by being dropped. For general work three principal types of automatic welding machines have been devised. In one case the welding heads are stationary and the work to be welded is rotated past them; in another machine, suitable for welding on large diameters, radial arms on the machine are made to rotate. A third machine is for straight line welds, and here again the work is stationary and the welding head is moved. In the matter of automatic arc welding the American manufacturers appear to be ahead of British manufacturers, but the work that is being done in this country is thoroughly good. If American methods are found desirable they will no doubt be introduced in due course.

In these days of high wages and severe foreign competition the development is of considerable importance, and we are glad to find that some British manufacturers have adopted the scheme. Nothing is more essential than to recognise that old and well-tried ideas are not always the best. When welding was in the experimental stage such a radical departure from orthodox practice would have been out of the question, but there is no longer any doubt that the system is sound. Moreover, it offers distinct advantages. Large machines frequently have to be sent long distances and reduced weight and less likelihood of damage are matters of no small importance. Again, in electrical work designs are constantly changing and the manufacture of many large patterns is an expensive business. Developments in the art of arc welding and cutting have marked a new era in the design of electrical machines, particularly those that are large and special. The possibility of obtaining a structure that is homogeneous and free from defects such as are often met with in castings, and which does not call for patterns, is surely a matter that no large electrical firm can afford to neglect.

Literature.

Applied Elasticity. By S. TIMOSHENKO and J. M. LESSELLS. Westinghouse Technical Night School Press, East Pittsburgh, Pa.

THERE are some interesting and important features in the first part of this work, as might be expected from the pen of an eminent applied mathematician so well known in this field, and unusually well acquainted with continental work on the theory of elasticity as Mr. Timoshenko.

Very little attention is paid in English text-books to the usefulness of the Mohr circle for explaining in a graphical manner the essential features of various stress theories. Although the essential elements of the geometrical constructions can be derived from Rankine's method of treating combined stresses, it has been pushed much farther on the Continent, and an elementary account here is a very useful feature of this book.

Another is the section on the torsion of shafts, which, in addition to much familiar theory, gives an account of Willers' graphical method of finding the stress distribution in circular shafts of variable cross section, an important problem when shafts are turned down at the bearings. This section also includes an elementary treatment of the membrane analogy, first developed by Prandtl in order to find experimentally the distribution of shear stress in shafts of any kind of cross section.

An account of the bending of beams when supported on elastic foundations is a feature of the chapters on the bending of beams, and is of interest to railway engineers who have to deal with railway tracks. Lord Rayleigh's very useful method of approximation for the solution of vibration problems in bodies of non-mathematical shapes also receives attention and acknowledgment. These are merely a few of the salient characteristics of a book which also covers a great deal of the ordinary theory of the stresses in materials and frameworks.

The second part deals almost entirely with the results of modern experimental investigation, and as such is a useful compendium, but there is little or no explanation of what these results mean nor is there any serious attempt to co-ordinate them.

SHORT NOTICES.

A Manual of Marine Engineering. By A. E. Seaton. London: Charles Griffin and Co. 1928. Price 40s.—In the ten years which have intervened since the eighteenth edition of Mr. Seaton's well-known book and the new twentieth edition just to hand, many changes have taken place in marine engineering practice. In his preface Mr. Seaton refers to steady hold which is still maintained by the triple and quadruple-expansion engine in its varied forms, and the advances made in geared turbine oil engine and electric propulsion. The general text of the book has been revised and brought up to date, where necessary, by the addition of new paragraphs and illustrations, and in the two appendices devoted to marine internal combustion oil engines and turbines aboard ship particulars and illustrations of some of the newer installations have been added. The advance of marine practice in the last few years has, however, been so marked that, in a further edition of this standard treatise, it might be advisable to add still further to the historical and technical value of its chapters by dealing in a more detailed manner with the developments in main propelling and auxiliary machinery to which the author has called attention. The new edition of Seaton is well illustrated and printed, and the volume may be looked upon as an indispensable handbook for the marine engineer and for students of marine engineering.

BOOKS RECEIVED.

Balistique Extérieure Théorique. By G. Sugot. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins.

The Great Engineers. By Ivor B. Hart. London: Methuen and Co., Ltd., 36, Essex-street, W.C. 2. Price 3s. 6d. net.

The Journal of the Municipal College of Technology, Manchester. Manchester: Published by the Education Committee.

Patent Law and Practice. By A. W. Griffiths. London: Stevens and Sons, Ltd., 119–120, Chancery-lane, W.C. 2. Price 7s. 6d. net.

Letters to an Absentee Director. By J. Lee. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 5s. net.

Alternating-current Motors and Starting Gear. By L. E. Wood. London: The *Electrical Review*, Ltd., 4, Ludgate-hill, E.C. 4. Price 4s. net.

Transactions of the Institution of Civil Engineers of Ireland. Vol. LIII. Dublin: Printed for the Institution by Falconer, Sackville-street.

Fire Protection in Factories. Safety Pamphlet No. 13. Issued by the Home Office. London: His Majesty's Stationery Office. Price 6d. net.

Balistique Intérieure: Théorique et Tables Numériques. By G. Sugot. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 40f. net.

Building Science Abstracts. Vol. I. (New Series), No. 7. July, 1928. Abstracts Nos. 1161–1372. London: H.M. Stationery Office. Price 9d. net. 1928.

Note on Composite Index Numbers for Indian Railways. By W. G. Barnett. Calcutta: Government of India Central Publication Branch. Price 6d. net.

Elimination of Waste, Simplified Practice—One-piece Porcelain Insulators. Washington, U.S.A.: United States Government Printing Office. Price 5 cents net.

Reinforced Concrete Bridges. By W. L. Scott. Assisted by C. W. J. Spicer. Second edition. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 25s. net.

Report on the Trade, Industry, and Finance of Syria. Dated May, 1928 (Department of Overseas Trade). By H. E. Satow, H.M. Consul-General at Beyrout. Published by H.M. Stationery Office. 1s. net. 1928.

Mail and Passenger Steamships of the Nineteenth Century: The Macpherson Collection with Iconographical and Historical Notes. By Captain H. Parker and F. C. Bowen. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price £3 3s. net.

Tests of Some Home-grown Timbers in their Green Condition, being Progress Report No. 1 of Project No. 1 of the Forest Products Research Branch of the Department of Scientific and Industrial Research. Published under the authority of H.M. Stationery Office. Price 9d. net. 1928.

The Connection Between Lift and Circulation for an Inclined Flat Plate. By A. Fage, A.R.C.Sc., and F. C. Johansen, B.Sc, being Reports and Memoranda No. 1139 (Ae. 308) of the Aeronautical Research Committee of the Air Ministry. Published by H.M. Stationery Office. Price 6d. 1928.

A Study of Absenteeism in a Group of Ten Collieries, being Report No. 51 of the Industrial Fatigue Research Board of the Medical Research Council. By H. M. Vernon, M.D., and T. Bedford, Ph.D., assisted by C. G. Warner, B.Sc. Published by H.M. Stationery Office. Price 2s. 6d. net. 1928.

The Determination of the Horse-power Height Factor of Engines from the Results of Type Trials of Aircraft, being Reports and Memoranda No. 1141 (Ae. 310) of the Aeronautical Research Committee of the Air Ministry. By J. D. Coales and A. L. Lingard. H.M. Stationery Office. Price 6d. net.

Tests of a Metal Aircrew in a Closed Tunnel for Comparison with American Tests in an Open Jet Tunnel. By H. C. H. Townend, B.Sc., and J. H. Warsap, being Reports and Memoranda No. 1137 (Ae. 307) of the Aeronautical Research Committee of the Air Ministry. Published by H.M. Stationery Office. Price 6d. 1928.

SIXTY YEARS AGO.

IN our issue of September 11th, 1868, we devoted a leading article to a memorial notice of the life of Christian Friederich Schönbein, the illustrious chemist, who had died at Basle the week before. Schönbein was born at Mitzingen, in Würtemberg, in October, 1799. After studying at the Universities of Tübingen and Erlangen he was appointed in 1824 teacher of chemistry at the Keilhau training school. Subsequently he visited England and thereafter spent some time at the French schools. In 1828 he was called to the chair of chemistry at the University of Basle, and in that post he remained for the rest of his life. Schönbein is to-day chiefly remembered as the discoverer of tri-nitro cellulose or guncotton. His discovery of an explosive cotton wool was made in 1845, but for a time he kept the method of its preparation secret until some independent workers, Böttger and Otto, made the process known. From these discoveries there resulted, not only a new explosive, but a new material, collodion, and to them we may now ascribe the development of processes for the manufacture of artificial silk. Schönbein's real interest as a philosophical chemist was, however, as our notice recalls, centred on the phenomenon of oxidation and in particular the nature of ozone. To-day ozone is regarded as formed by a grouping of three oxygen atoms into a molecule instead of the usual two in the oxygen molecule. It is of interest to note that Schönbein's researches led him at first to believe that nitrogen was the source of the ozone produced in air by the action of moist phosphorus or in the oxygen liberated on the electrolysis of water. Following this clue, he argued that nitrogen was not really an element, but a compound of ozone and hydrogen. Subsequently he held that ozone was really to be regarded as a peroxide of hydrogen. In 1858, however, he developed the view that ozone was "negative oxygen" and claimed to show that a corresponding positive oxygen or "antozone" existed, although so far it had never been found in the free state. Ordinary oxygen was a product of the combination of the two ozones. Up to the date of our notice of Schönbein's life the real constitution of ozone had not been fully demonstrated, although ozonised air was being made use of in a process of bleaching recently developed.

The British Association.

SECTION G.—ENGINEERING.

SIR WILLIAM ELLIS presided at the opening meeting of this Section on Thursday, September 6th, when the first business was the presentation of a paper by Mr. J. W. Thierry, which dealt with the engineering features of the Zuyderzee Works. The author is a well known Dutch civil engineer, and was introduced by the President in felicitous terms, who commented on the high standard of the papers before the Section, and especially the high standard of the work described in Mr. Thierry's paper. Sir William added that he himself had been serving on a Government Committee which had been dealing with the subsidence area of the Doncaster district, and the report of that Committee, which dealt with similar matters to those in the paper, had been accepted. Incidentally, Sir William Ellis mentioned that it was one of Mr. Thierry's countrymen who in the reign of Charles I. did a large amount of reclamation work in the East of England, much of which still remains.

ENGINEERING FEATURES OF THE ZUYDERZEE WORKS.

The plans for enclosing and reclaiming the Zuyderzee date from eighty years ago, but their realisation came about only ten years ago, when, after long hesitation, the desirability of reclaiming the land had become urgent and hydraulic engineering and the technics of dredging had made such progress that the execution of these difficult and extensive works became possible. The work was authorised by an Act of June 14th, 1918, and a certain amount was done until 1925. A fresh start was then made, and the work has been progressing rapidly since. The Zuyderzee is described as a gulf penetrating far into the land; the northern part (Waddenzee) consisting of shoals intersected with deep channels, the southern part having an even bottom but a small tidal change. According to the general scheme of the works, a heavy bank will enclose the southern part of the gulf and of the area to be enclosed, amounting to 915,000 acres, four parts (having a total area of 550,000 acres), will be reclaimed separately. In the centre, a fresh water lake (Yssellake) of 270,000 acres will remain as storage basin to receive the water of the river Yssel and other tributaries. This lake will discharge into the Waddenzee by twenty-five sluices in two groups, each sluice being 40ft. wide. The total cost of the enclosing works has been estimated roughly at £9,000,000, whilst the cost of reclaiming the land is put at £38,000,000. The returns from the reclamation, however, are estimated at £42,000,000. Thus a profit is shown, but the author's view is that even if there was a deficit of four times the estimated profit the national advantage of the scheme would amply justify it. The whole of the works, if conditions remain favourable, are estimated to be completed by 1952. The enclosure of the Zuyderzee will be completed in 1934, the work upon reclamation proceeding meanwhile.

The paper contains minute details of the manner in which the work of enclosing and reclaiming is being carried out. One of the most interesting features of the work has been the influence upon the tides in the Waddenzee of the enclosing works, and it was found that the tidal range would increase, especially in storms, to a higher level than at present. As a result, the enclosing dam has had to be constructed with a higher crown than was deemed sufficient previously, and the sea banks round the Waddenzee have had to be heightened.

The enclosing dam will consist of a boulder clay core with a body of sand covered with clay behind it. The slopes are faced with stone pitching and the toes are protected from scour by mattresses of brush work. The height of the crest of the dam varies from 20ft. 4in. to 24ft. 8in. above the normal Amsterdam level, and the construction of a railway and a road along it is projected. The dam, which has a total length of 18¼ miles, is to be built in such a way that the tidal current around the head of the work will cause the least possible inconvenience. The enclosing will be effected gradually over a period of eight years, and the final closing will be effected in two places simultaneously, where the deepest channels have to be crossed. For that purpose, artificial bars or sill dams will be constructed in the channels to serve as a base for the superstructure of the dam. The banks of the areas to be reclaimed will be constructed on the same principle as the enclosing dam, viz., a core of boulder clay and a main body of sand. After these banks have been constructed, the water will be pumped off the embanked areas and canals, but drains and roads will have to be laid before the soil can be cultivated. The capacity of the pumping plants will be sufficient to drain off a rainfall of ½in. per twenty-four hours in the same period.

Mr. J. S. Wilson, in congratulating the author on what he termed a colossal piece of work, commented on the difficulties likely to be encountered with this class of operation, although in this case the depths were not very great. The paper brought out the importance of civil engineering research, and in this particular case an enormous amount of civil engineering research had had to be carried out to render success possible. In order to ascertain the tidal effects of cutting off of such an enormous inland area, it was necessary to have records of simultaneous observations at many points, and that was work which could well be carried out by engineering students, as the author had done, whereas the ordinary civil engineer could not afford so many qualified assistants. One of the spectacular things about this work was the final closing of the openings, which was one of the most difficult problems in relation to enclosing work. In the author's case, the depth was not very great, but in the case of the Assouan Dam, there was a very deep passage left, and as the passage became narrower so the velocity of the water increased, and, for a while, defeated all attempts at the final closing up. The biggest stones were washed away, and eventually the trouble was overcome by filling three or four railway wagons with big stones, lashing the wagons together and running them into the opening. That enabled the dam to be completed.

Dr. J. S. Owens, speaking of the difficulty of closing gaps for the completion of dams, referred to a case in South Ireland, where he gradually built up from the bottom. In that way, the velocity of the water was not increased so much; indeed, it was decreased. In that case he put down rows of sheet piles, and built a sort of cofferdam, and in all this kind of work the basic principle was to reduce the velocity of the water. He asked how long would it be before the reclaimed land would be ready for cultivation.

Professor G. Cook pointed out that the author had stated that although the Yssellake would receive the silt from the river Yssel and tributaries, it would not silt up, but he failed to see why it should not. He also asked if the predictions of tidal effects were made by calculation or whether models were used. Personally, he only knew of one instance of the use of models in tidal matters, and that was by Osborne Reynolds thirty or forty years ago. He believed Professor Gibson was engaged in similar work in connection with the Severn Estuary with marked success, and that was a case where model tests might be particularly useful owing to the magnitude of the work and the great capital outlay.

The President, proposing a hearty vote of thanks to the author, said the section could not have started its meetings with a more suitable paper. There might be some who were interested and would wish to see the works. Could the author indicate the nearest point where the work could be seen and the best way to get there?

The Author, who did not reply to the discussion at the meeting, said he would be pleased to give anybody all assistance in the matter mentioned by the President, if they communicated with him.

THE EDUCATION OF THE ENGINEER.

There was a crowded meeting at the joint discussion which followed between Sections G (Engineering) and L (Education) on the subject of "School, University and Practical Training in the Education of the Engineer." Dr. Cyril Norwood (President of Section L) took the chair and the discussion was opened by Sir William Ellis (President of Section G).

Sir William Ellis said that although as an engineer he held personal views on this matter, he thought it more suitable for him as President of the Engineerng Section to set out certain points which would be likely to provoke discussion. First of all, there was the question of the extent to which it was desirable that public schools should go in giving opportunities for boys in the latter part of their school career to specialise in subjects cognate to the profession which they thought of adopting. It must be realised that there were many boys who at sixteen years of age had not made up their minds what career to adopt in life, and in taking up engineering after leaving school they would probably have to devote any further educational opportunities to dealing with subjects directly relating to engineering. That might prevent them getting any further general education which would place them at a disadvantage in later life compared with those who had gone further in their general education in their school days. There was a tendency in the medical profession for a boy to specialise to the extent of training for the first M.B. whilst at school, and if that could be done without encroaching on the opportunity of going farther in general education, could not the same method be adopted in engineering? The next point was whether the practical training in engineering should immediately follow the school course or whether it would be best to take it after the university course. Sir William set out the now well-known arguments on both sides of the problem, but did not express any definite views of his own, although he referred to the advantage of a boy getting his practical training when a boy, at which time, he suggested, the workmen are more willing to give advice and encouragement than they are when the boy is some years older, as, for instance, after the university course. Expediency, however, he said, must be the deciding factor. As regards the "sandwich" system, it was pointed out that it was working reasonably satisfactory in those places where there were several pupils, and mention was made of the fact that that system was somewhat similar to that adopted in the training of mining engineers. Finally, Sir William Ellis commented on the length of the university course and expressed the view that although four years was to be preferred to three years, the newer courses being arranged by the universities over three years did not place the same financial strain upon parents, and he urged the desirability of adhering to three years. It was suggested that the first two years should be carried out on the usual lines, but in the third year the student should be given the option of taking his honours course in one or other of the branches of engineering rather than imposing on the student a high level of engineering knowledge as a whole. That appeared to him to be feasible.

Colonel Ivor Curtis urged a closer approximation between the apprenticeship training of the skilled worker and that of the professional engineer. Anyone who had had to design a system of engineering training would appreciate that it was essentially one of time, and that only by growing up within the industry could a boy learn to recognise the problems a knowledge of which was the hall-mark of his profession. As an aftermath of the war the country was fighting for its existence as an industrial nation. To live, it must design better, produce more cheaply, give better value and sell better than its rivals. Training for production and management had become a vital issue. Those circumstances, together with the decay of the old apprenticeship system, combined to render very necessary a reconsideration of existing systems of education and training. The fundamental problem was how to secure the three essentials—workshop training, technical education, and general self-development—during the pre-university stage without the sacrifice of any one of the three to another. He argued that the Air Force system of training achieved that object, and suggested that there was something to be learned by those concerned with the general training of engineers, from the results which had been achieved. The Air Force scheme provided for taking well-educated boys between the ages of fifteen and seventeen years—a certain standard of education had to be reached—and giving them practical training with only eight hours' technical education per week. By that scheme 7000 boys had been dealt with, 4000 having been passed out into the Service and 3000 being in training. In order to be passed out the boys had to pass certain tests in skill in handicraft as well as knowledge from the examination point of view, and the number who fail was very small. The technical knowledge had been found to be of a higher standard than was originally expected with only eight hours' technical education per week, and it had been also found that the boys who passed out could hold their own with cadets entered for open competition from the public schools. By that scheme it was claimed that the three essentials he had outlined could be obtained during the ages of sixteen and twenty, whilst the more able boys would be ready to proceed direct to a course of university standard. He admitted that that scheme did not appeal to the more scholarly type of mind capable of dealing with abstract ideas, but it afforded a whole-time education for the practical-minded boy. As a result of that experience he suggested that there appeared everything to be gained by the schools of the country developing special part-time departments for the training of what he had termed the practical-minded boy, after the conclusion of the usual secondary school period, so that those boys could remain at their old schools and share in the games with their old comrades. It was necessary to realise that a great change had come over the position. When engineering first sought help from the universities it needed most the design engineer and the research worker. To-day it needed help no less in the training of the practical-minded man for production and management. Could, asked Col. Ivor Curtis, the universities modify their long-established practice and outlook to meet that new demand and the needs of practical-minded men? At the same time he emphasised the necessity for a further widening of the interest taken in education by the professional institutions, especially from the point of view of the training of those for the higher positions. Finally, Col. Curtis recommended the formation of local advisory councils consisting of representatives of the management, the worker, the school or education authority, the teacher, the parent, and the boy, and from those he foreshadowed the evolution of a national advisory council.

Sir James Henderson, enlarging on a few of the points mentioned by Sir William Ellis, spoke of the great difference between the practical training afforded at technical education institutions and the actual conditions obtaining under commercial conditions. Again, the school or university could never teach a student those qualities which came only by judgment and experience and no combination of school and university education could turn out an engineer according to the definition of the charter of the Institution of Civil Engineers. Any claims which gave that impression should be avoided, and it was from that point of view that the degrees of bachelor of engineering and master of engineering, granted by some of the newer universities, were to be deprecated. The terms B.Sc. or M.Sc. as adopted in the older universities were to be preferred. By all means train boys to use their hands, but it must not be assumed that such a boy was an engineer. Indeed, the word "engineer" was greatly misused, and what was needed was a combination of the various professional institutions to stop that misuse and close the profession against the unqualified in the manner the medical profession was closed.

Professor A. L. Mellanby expressed the view that

the great majority of students taking the engineering courses at universities and technical schools did not require the advanced courses which they were compelled to take, and what was needed was active co-operation with industrial concerns so that the educational authorities could the better meet the needs of industry. The higher university technical courses were only suitable for those whose duties would lie in the direction of design and research, and they were a relatively small proportion of the whole of engineering students. The great difficulty had been that in general in the recent past industrialists had been reluctant to admit the value of technical education. For a long time they had decried technical educational schemes, and although that attitude was changing it was yet not quite clear that the appreciation of technical education was practical or that co-operation with the educational authorities was fully effective. With the exception of a few firms which had special schemes of their own, the importance of technical education was not yet fully recognised despite the growth and power of foreign competition. As the result of his own experience he suggested that beginners' courses in engineering should be free from the so-called preliminary work in science and a descriptive and explanatory form of engineering should take its place. There should be a system of graded scholarships which would ensure that youths of promise could be passed on to the higher schools and universities without delay, and there should also be a national system of apprenticeship combining works education with class training, and linked up with it should be a scheme for ensuring that the higher appointments in engineering were only filled by the truly qualified. The question of the higher qualifications for the more important posts was a matter for the engineering institutions rather than the educational institutions.

Sir Henry Fowler expressed regret that there were not more industrialists present, and added that there was much he could criticise in the Air Force scheme which must only be regarded as an experiment. Whilst appreciating the advantages of the schemes, it could not be said to be an industrial training, and there was no doubt that a boy received the greatest possible education from the administrative point of view when working side by side in an industrial shop with the men there. The real point in the education of young men wishing to enter engineering was what can educationalists do to strengthen their character. It often happened that a man was a wonderful mathematician or had a wonderful knowledge of physics, but he lacked character, and in that connection it would have been an advantage to have some psychologists present. He had once been asked by the President—at the time—of the Psychological Section what he meant by character, and his reply was that if the President of the Psychological Section could not define that, he could not tell him. Quite recently most of the professors in the country had been asked to a dinner to discuss the general question of engineering education, and one of the points raised by them was what industry had to offer the students. That, he agreed, was a great difficulty, although it could not be discussed at the moment. His own idea of engineering education was to take a boy from the public school when he had not specialised too much on any one subject and place him in a shop for twelve months, during which time he should attend part-time classes. Then he should go to the university for three years and during vacation go back to the shop. Finally, he should have two years in the shops. The pupils at Derby were sent one day per week to Sheffield to improve their knowledge of mathematics. The most important thing, however, was to strengthen character.

Dr. W. W. Vaughan (Headmaster of Rugby) said that surely the whole object of education was to strengthen character. Whilst he was pleased to hear engineers asking for a general education carried as far as possible, yet the public schools were asked to surrender the boys at sixteen years of age. It was, however, impossible to send out a boy of sixteen with both a strong character and a good general education. So far as teaching something of engineering in the public schools, the difficulty was that educationalists knew little of what was being done in the shops and industrialists knew little of what was being done in the schools, and there was a great liability to judge the schools by the failures that came out of them. The fact was that many different types of person were required for all the professions and no one educational system sufficed for all those required in engineering or any other industry. There were those who made good subordinates, but who failed completely if placed in the top positions. Something like 50 per cent. of the boys in public schools to-day expressed a preference for engineering, but it would be absurd to suggest that all of them should be trained for the higher positions. The ideal, in his opinion, would be for a boy to leave school at seventeen or eighteen years of age, go for a year into a works and then pass on to the university. In his view, a student who went to the works before the university would be infinitely the more competent engineer and infinitely more agreeable as a human being, because he would have obtained a knowledge of human nature in the mass. Whilst headmasters were prepared to confess that they had failed in their efforts to produce character it must not be thought that that was due to want of trying. Character, after all, was a very hard thing to produce, and it was a very hard thing to examine, and any hints from engineers would be welcomed. At the same time headmasters could offer some hints to industrialists in the matter of maintaining character on the part of the young men they took into their shops, and particularly in recognising that most of those young men came there to learn and to progress. Too often by the tasks they were given, these young fellows became depressed and often degraded.

Mr. A. Lennox Stanton, who spoke as a psychologist-engineer, said he regarded the definition of an engineer mentioned by Sir James Henderson as out of date. In his opinion, an engineer was one who had learned the forces of Nature to such an extent that the maximum of efficiency could be produced with a minimum of waste. That was the definition he had endeavoured to apply in his engineering experience. One of the things most lacking to-day was the ability to pay attention to detail, and it was there that the American-trained engineer had the advantage of the English-trained engineer. We needed to develop the habit of patience, courage and perseverance to get down to details and essentials, and those who did that would get their reward by being able to climb to the highest positions. Finally, it was suggested that for the benefit of those who intended to enter one or other of the Government Departments lectures should be given by lecturers from those Departments pointing out the conditions and difficulties likely to be met with, such lectures to form part of the educational training for such posts.

Professor W. Kerr said that there was a new demand for development in engineering teaching which seemed to entail what might be termed educational research. Certain it was that a need existed for a separate training of those who had been referred to as possessing scholarly minds and those with practical minds, and he hoped that when the new schemes were devised it would be found that they avoided what he regarded as the overloaded nature of the engineering curricula.

Dr. J. Graham (Leeds) pointed out that in Leeds a series of scholarships had been established which gave equal opportunity to everybody of getting to the university. It had been found that the best return for the money was received from the boy who went from the secondary school at about sixteen years of age into the engineering shops, although it would be all the better if he stayed another year at the secondary school. The engineers, however, demanded that the boys should come to them at sixteen and from that point of view the engineers required a little education, because their outlook was too narrow. Those boys went into the shops for three years or four years, meanwhile attending technical schools at night—when they were too tired to get the full advantage. There again engineers themselves required educating. At the end of the workshop period the records of the boys were examined and if satisfactory the boys were granted a university scholarship for three years. During the time he had been at Leeds 120 boys had thus been trained, but the difficulty was that when they went back to the works they had been in and asked what could be done for them, more often than not they were told they could go back to their old machine at the old wages, and that after three years in the university.. The result was that most of them had gone abroad and were filling important posts. It was really only during recent years that engineers had ceased to be afraid of brains, and even now the attitude of industry towards technical schools was very different from what it was abroad, where the industries supported the technical schools out of the profits, whereas here the technical school was looked to to develop the industry. Happily, that attitude was changing, and for the first time that he could remember a President of the Board of Education, about three or four months ago, had actually blessed technical education and had suggested that a move forward was necessary. Up to the present technical education had been the Cinderella of all forms of education.

High-pressure Water-tube Boilers.

After Sir William Ellis had delivered his presidential address to Section G—see page 297—a paper on "The Design and Construction of High-pressure Water-tube Boilers" was read by Mr. H. E. Yarrow. Attention was first called to the fact that the increase in steam pressure and temperature—one of the outstanding features of modern water-tube boiler design—is not confined to electric power stations, high-pressure boilers having been introduced into many passenger and cargo vessels, in reply to the challenge of the Diesel engine, which some authorities a few years ago considered would supersede the use of steam for ship propulsion. Whilst a marine installation was hardly able to attain the same upper limit of efficiency as a land plant, the possibility of improvement shown in curves published by Messrs. Mellanby and Kerr last year in the "Proceedings" of the Institution of Mechanical Engineers—and reproduced by the present author—were stimulating and showed that even on a thermal efficiency basis the marine steam plant is not necessarily much lower than the internal combustion engine.

After setting out the recognised principles of design associated with high-pressure water-tube boilers and mentioning some of the features of the installations in large power stations, the necessity for pure feed water was emphasised, and it was also pointed out that with mechanical grates and air temperature of 400 deg. Fah. is approaching the limit, if the cost of repairs is to be kept within a reasonable limit, although with the introduction of heat-resisting materials there was no reason why air temperatures considerably higher should not be employed satisfactorily. With water-cooled furnace walls trouble has been experienced, owing to faulty circulation, and the author emphasises the need for careful consideration of the design of these walls.

Dealing with the mechanical construction of the boilers, it was pointed out that as boiler pressures increase so does it become more important to reduce or, if possible, to eliminate riveted or bolted joints and to adopt drums or headers of circular section. Steel makers are now able to supply hollow forged drums at a reasonable price, and although these are still more expensive than a built-up drum, it is recommended that forged drums with riveted ends should be used at pressures exceeding 500 lb. to 600 lb. per square inch. At very high pressures of 1000 lb. forged drums with closed-in ends should be used, thus entirely eliminating rivets. The method of manufacturing hollow forged drums, as carried out by John Brown and Co., Ltd., Sheffield, was then briefly described. Homogeneity as regards composition and freedom from defects is essential for forgings which are highly stressed, and these characteristics are obtained by the production of steel from selected materials in the acid open-hearth furnaces, this process enabling an adequate degree of de-oxidation and proper finishing conditions to be obtained. The moulds used for these castings are specially designed and have large refractory lined feeder heads, thus preventing the possibility of mechanical troubles from shrinkage. In order to secure sound material in the actual forging sufficient material is removed from the top of the ingot. When cold, the ingots are cut to length and a hole of considerable diameter is trepanned through them, so that the centre of the ingot is removed, and a careful examination of the ingot, internally and externally, can be made. The forging process adopted ensures a very thorough working of the material, the ingot being expanded and drawn, *i.e.*, the steel is worked both circumferentially and longitudinally. Up to this point the work for cylindrical drums and drums with closed ends is similar, but the remaining processes vary for the different types of drum. The cylindrical drums receive the requisite heat treatment immediately after the completion of the forging. The closed-in end drums, however, are bored after the completion of the forging process, and when cut to length are closed in, particular care being taken during the closing in process to ensure that the deformation of the material takes place gradually. The forgings are then carefully heat treated so that the physical properties of the boiler ends are similar to the rest of the forging, so that dangerous internal stresses are eliminated. The last process is the machining of the drums, the finished article being machined both inside and outside. Solid forged drums are made in steel of 28 to 32 tons or a higher tensile steel of 34 to 38 tons, which latter material offers the advantage that it enables the thickness of the drum to be reduced.

It was also pointed out in the paper that a large number of welded drums are being made on the Continent for high pressures, such drums being cheaper than forged drums.

Discussing some figures of tests upon the effect of temperature on three different classes of steel, viz., a 3 per cent. nickel steel, a nickel-chrome steel and various carbon steels, the author pointed out that the results were obtained after a very short period of time and that the effect of "creep" must be taken into account. When this was done it appeared that a temperature of 750 deg. to 800 deg. Fah. seemed to be approaching the dangerous limit if ordinary carbon steel were used. Materials, however, were available in alloy steel which enabled the use of higher temperatures and were important from the point of view of the superheater, upon the design of which temperature had a considerable bearing, whereas it did not seriously concern the designer so far as the boiler itself was concerned. An interesting series of experiments was recently carried out at Brown, Bayley's works in Sheffield to investigate the most suitable material for superheater tubes. Three samples were chosen: a nickel-chrome-iron alloy, a chromium-iron alloy, and an ordinary mild steel. The experiments indicated that both the nickel-chrome-iron and the chromium-iron materials were highly immune to the attack of furnace gases and are, in this respect, superior to ordinary mild steel. Tests were then carried out on the tubes by passing steam through them, the steam entering at a temperature of about 750 deg. Fah. and leaving at about 1000 deg. Fah., the temperature of the tube being kept at about 1000 deg. Fah. by passing an electric current through it. In this case the tubes of nickel-chrome-iron and of chromium-iron were found to be not attacked although the experiment had lasted several weeks. The result of the experiment with the mild steel, however, was unsatisfactory. The tests proved the immunity of nickel-chrome-iron and straight chromium-iron alloys from oxidation, and assuming such heat-resisting tubes could be manufactured at a reasonable price, it would enable higher steam pressures to be used with safety.

Whilst the paper did not discuss in detail boiler mountings and other fittings, special attention was directed to the need for improvement in the design of feed water regulators for high-pressure boilers so as to ensure an instant and reliable response to feed water demands and a constant water level irrespective of pressure fluctuations in the main feed. A two-pressure stage boiler was suggested as a possible line of development in this connection. Safety valve equipment, it was pointed out, also requires special consideration, as the cutting action of high-pressure steam will quickly make a small leak between valve and seat serious. This is usually overcome by installing small pilot valves which give warning before the main valves lift, thus enabling the operator to prevent the main valves coming into action too often.

Professor A. L. Mellanby remarked, in the discussion, that although great advances were being made in the use of high-pressure boilers, there was still a certain amount of scepticism on the part of some people who did not appear to think that the results claimed were being obtained. This paper at least served the purpose of demonstrating what was being done. At the same time, it appeared to him that the high-pressure boiler was suffering from something of the kind that the reciprocating engine suffered from when it was introduced. Everybody was then told that the more the steam was expanded the greater the efficiency, and that if very large engines were constructed with considerable expansion, very high economy would be obtained. That, however, had been shown to be quite wrong, because when the necessary losses were taken into account, it was soon found that there was a theoretical limit to expansion or to the size of the engine. Much the same thing was taking place with regard to high-pressure boilers. There was a general opinion that it was possible to continue to increase the pressure and temperature and obtain increasing economy. That, however, was not the case. When we took into account the losses introduced by these high-pressure boilers, it would be found that within a certain limit of range there was very little advantage, and in his opinion many people to-day were using steam pressures which were higher than the investigations at present justified from the economic point of view. Some years ago Professor Kerr and himself read a paper on the subject, and they were attacked for recommending very high pressures. As a matter of fact, they were not recommending these very high pressures, but were simply stating what would occur, although at the same time venturing to predict that these high pressures would be adopted. There was some natural instinct in engineers to get the best possible, no matter the cost, and there would always be found some engineers who, for the sake of the higher efficiency, would adopt the highest pressures. As a matter of fact, although there was a large number of high-pressure installations now in operation all over the world, he felt that there was a tendency to go beyond what economy dictated. The pressure problem was not so great as the temperature problem, the reason being that in dealing with very high temperatures the strength of the material diminished very rapidly as a certain temperature was exceeded by a degree or two. A rise of 10 deg. above the limiting temperature meant a considerable reduction in the strength of the material. Therefore, the materials problem was the one which required most attention, and it was reassuring to know that there were so many metallurgists engaged upon it. The use of high temperatures and pressures would mean the saving of the steam engine and the steam turbine, but, following the motto of the Scottish Automobile Club, his advice was to "gang warily."

Sir Henry Fowler, referring to the use of high pressures and temperatures on boilers for locomotive work, said he did not mean the pressure of 350 lb., which was being used in America, but the much higher pressures which were being used on the Continent, and which were being seriously considered by the locomotive engineers of this country. Twelve months ago he had a run on the Schmidt-Henschel locomotive working at 900 lb. pressure, steam being generated at 1400 lb. in a tubular boiler used for heat transference only. This year he had had an opportunity of taking a longer run on the footplate of that locomotive, and it was obvious that there was economy in fuel consumption. There was also running in Switzerland a locomotive which he hesitated to call a water-tube locomotive, although there were tubes in connection with it, and it ran at a high pressure very satisfactorily. Again, a German locomotive company had a locomotive which on paper looked complicated, but it ran at from 700 lb. to 1000 lb. pressure, whilst the Benson people were working in conjunction with another locomotive company and were experimenting with pressures running into thousands of pounds. Therefore, in spite of the difficulties, locomotive engineers were looking to high pressures. Unfortunately it was not the technical side which was the difficulty; it was the commercial and economic side. It was appreciated that if these high pressures were used, a turbine must be employed, and on a locomotive its use involved many difficulties and a great deal of money. Indeed, he had seen one proposition by which it would be necessary to save rather more than all the coal to counterbalance the extra cost of using high-pressure steam. The tubes on the 1400 lb. pressure boiler he had mentioned were made of nickel steel; otherwise ordinary steel was used, and this Schmidt-Henschel boiler had been running a matter of 20,000 or 30,000 miles without any tube trouble, the water being distilled water, in that case. He asked whether the 34 or 38-ton steel mentioned in the paper was a plain carbon steel or a nickel steel.

Mr. Yarrow said it was a plain carbon steel.

Sir Henry Fowler said that was interesting because at the present time there was a tendency, both in plain carbon steel and in association with silicon, to look for a cheaper steel than 3 per cent. nickel steel.

Sir John Biles said that pulverised fuel was being tried for marine work, and the stage had been reached where it was successful, in a cylindrical boiler. On the other hand, Messrs. Yarrow at Scotstoun had had put down an experimental plant for using pulverised fuel on tubular boilers, and he advised all those interested to try and see this plant, which demonstrated one of the most advanced stages of this very important development. Whilst these efforts were being made to utilise pulverised fuel in the cylindrical boiler, the future development of steam production and in the use of coal for marine purposes must follow on the lines of the water-tube boiler and turbine. There was no doubt about that, and he felt confident that the application of pulverised fuel for marine purposes would meet with success, which must be considerably to the advantage of the coalowner, and at the same time rapidly lead to very high efficiencies in coal consumption in the mercantile marine. The Government, too, are taking an interest in this matter because the Department of Scientific and Industrial Research had appointed a Committee, in conjunction with its own staff, to apply on board a ship lent by the Admiralty any method of pulverising fuel for cylindrical boilers so that the relative merits of the different systems of pulverising would have an opportunity of being tested. In all these questions of thermal efficiency, however, it was necessary to take into account the extra capital cost and the on-costs involved in order to get a true balance sheet of the final result commercially.

The President remarked that a large number of welded boilers were being made, and in America he was surprised at the wonderful work being done in this connection. At the same time, whenever he put the elementary question, whether in the case of tensile strain they would avoid the welded structure, the answer was invariably "Yes," and whilst he admired some of this work in America he had said, "If you could do away with welded work and have solid, would you prefer it?" The answer again invariably was "Certainly." He also would rather not have a weld if he could avoid it. Sir William then drew a curve on the board to show that at 750 deg. Fah. the boundary line of tensile strain was reached with ordinary mild steel, and for that reason he argued that the problem was not so much one of pressure as one of temperature. It was no use thickening everything up to take pressure if there was going to be creep above a certain temperature, and he put the danger zone at 750 deg. Fah.

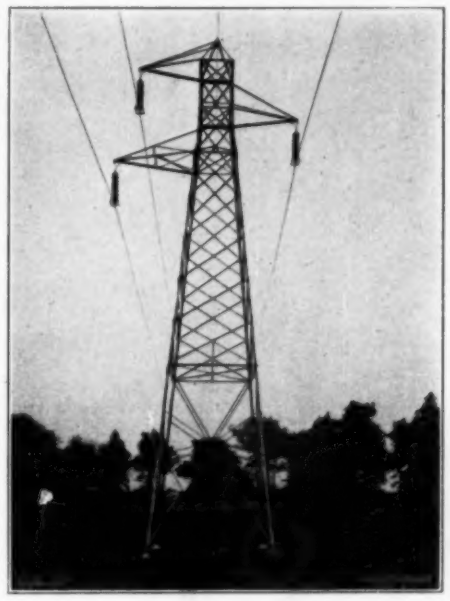
Mr. W. Marriner also spoke in favour of solid weldless drums for high pressure boiler work, and added that the manufacture of them increased one's admiration for the artificers engaged upon their production. In addition to the advantages to be obtained on board ship by the use of high pressures, *qua* the boilers themselves, there were the incidental advantages accruing to the ship generally by the smaller amount of coal to be carried, so that the use of high-pressure boilers should enable the ship designer to gain considerable advantages in many other directions. In other words, progress in one direction always reacted to the advantage of the whole. Personally he was convinced that boilers would be used on ships at much higher pressures and temperatures than those spoken of to-day.

Professor F. C. Lea said that having seen the manufacture of solid drums for high-pressure boilers, he could speak of the success that had been achieved, not only in increasing the economies from steam engines but in the technical craft of making these drums during the past few years. In connection with this matter of high pressures and temperatures, a paper which he himself published some years ago was now receiving considerable attention all over the world. It dealt with the limiting creep stress of the material, and not the strength of the material at all. The important thing to know in relation to the use of high steam pressures and temperature was what would be the strength of the material with time, *i.e.*, in actual operation. Experiments had shown that a material which had a strength of 20 tons at, say, 500 deg. Cent., after a time was reduced to 5 or 6 tons, and that was what was meant by the limiting creep stress. In the case of the ordinary steels, corrosion was a serious problem as affecting the life at high temperatures. At the moment, some special anti-corroding steels were being made which were very much better than the carbon steels, and that was a great gain, and these same steels had better properties for resisting high temperatures provided the temperature was kept below 800 deg. Cent. At that figure, recent experiments had shown that even some of the best steels for resisting high temperature would, at a temperature of 800 deg., have their strength reduced from, say, 15 tons to 2 tons in fifty-three weeks, and he had estimated that in 1½ years the strength would be reduced to 1 ton per square inch. Therefore, it was apparent that above a certain limit, say, between 500 and 800 deg. Cent., small changes of temperatures meant very considerable changes in the limiting creep stress.

(To be continued.)

The Central Scotland Electricity Scheme.

THE first of the schemes for unification and co-ordination of electric power on a national basis is at present being carried out and the many months of preliminary investigation on the part of the Electricity Commissioners and the Central Electricity Board are bearing fruit. The Central Scotland electricity scheme aims at linking up the main generating stations in the important industrial area lying round the valleys of the Clyde, Forth and Tay, and includes the principal shipbuilding, engineering, colliery and general manufacturing areas of Scotland, from Kilmarnock to Dundee. The population of the area is roughly three-quarters of that of the whole country. The contract was



awarded to British Insulated Cables, Ltd., as it was thought that probably it was the only firm in the country in the position to start right away, owing to the fact that the company was already carrying out a scheme on somewhat similar lines in the Far East.

The accompanying illustration shows one of the towers that has been erected.

American Engineering News.

Machine Welding for Structural Steel.

For the shop welding on large members, such as bridge chords or booms, plate girders and columns, a machine has been developed by Mr. G. A. Caldwell, of the Mississippi Valley Structural Steel Company. The bed of the machine forms a long table with power-driven or live rollers for carrying the material past the two electric welding heads which are mounted on each side of the bed and a little above it. The operator can regulate the speed of feed from 2in. to 40ft. per minute. The rollers are reversible and welding can be done on material moving in either direction. The welding heads are adjustable vertically, laterally and longitudinally, so as to be adapted to parts of various sizes and shapes. They can make continuous welds or they can automatically make stitch-stitch or intermittent welds of any desired length and spacing. Automatic stitch welding includes cutting off the arc, speeding up the table travel to bring the next position of weld to the welding head, slowing down the travel to welding speed, striking the arc, making the weld, and again cutting off the arc. A single switch changes the operation to continuous welding and cause the feed to operate continuously at any desired speed.

Long Concrete Viaducts.

A feature of the enormous programme of highway construction in the United States, resulting from the almost incredible increase in the use of motor vehicles, is the construction of long viaducts through swampy or marshy districts, or to give direct routes across wide bodies of water. Thus the structure crossing Lake Pontchartrain is nearly 5 miles long, while Tampa Bay, in Florida, is crossed by a 3-mile viaduct with approach embankments, making a total crossing of about 6 miles. Both of these structures embody concrete trestles, having rows of concrete piles, 24ft. apart, capped by transverse girders carrying longitudinal girders on which is the concrete road slab. At the Tampa—or Gandy—viaduct, the water is 6ft. to 24ft. deep, and concrete piles, 20ft. to 60ft. long, were driven to rock. For some distance the rock is bare and there holes, 24in. diameter, were drilled to a depth of 8ft. by means of a drill barge putting down four holes at a time. A pile-driver barge, with four sets of leads and an A-frame derrick, would set four piles at a time, and about thirty-two piles in a day. A floating concrete plant built the transverse caps on the piles, and a similar but larger plant built the longitudinal beams and deck slab in lengths of 112ft., or eight spans. The parapet also consists of concrete posts and rails.

The Diesel-Electric Oil Tanker Brunswick.

No. II. (*conclusion*).*

In our previous article we dealt principally with the design of the vessel, the type of propelling machinery employed, and the results obtained on trial. We now proceed to describe the four engines driving the main generators and to give some account of the lay-out of the engine-room auxiliary machinery and that specially employed for the cargo services. We may remark that the auxiliary machinery is so designed that the power required for its operation is remarkably small. During the trial runs the total power consumed by the auxiliaries was only of the order of 1¼ per cent. of the propelling power.

Main Generator Engine Design.

The design of the Ingersoll-Rand type of airless-injection vertical marine engine has not previously been described in THE ENGINEER, and some reference may fittingly be made to certain points in it which, the makers claim, contribute towards that reliability of operation and ease of upkeep which are essential factors in tanker operation, with its long voyages and quick turn rounds. The design has already proved successful in the earlier vessels of the Atlantic Refining Company, which are propelled by the same type of engine, and in internal combustion locomotive service in America.

In the engines we are at present considering the specification drawn up by the engineers of the Atlantic Refining Company was followed, and some slight modifications and improvements have been added to the original American pattern of engine by Carels Fréres with their long and wide experience of Diesel engine construction.

As the drawing—Fig. 4—shows, the engine has a bedplate of deep section with broad flanges which are ribbed and bolted to the specially prepared engine seatings. The bed-plates are grouted up in final position with type metal having a 17 per cent. anti-mony content, which causes it to expand slightly when cooling and so to make a solid bed of metal over the entire bearing surface. No chocks are employed, the engine being levelled by screws which are withdrawn after the type metal has set.

Attention may be called to the special type of main bearing illustrated in Fig. 5. The top cap is fixed and the bottom shell of the bearing is supported on an adjustable wedge block, the position of which is determined by long bolts terminating at either side of the bed-plate. The bearing caps are narrower than the lower halves of the bearings, which are flanged in order to prevent lateral movement. The wedge arrangement maintains the alignment of the crank shaft and enables quick and easy adjustment to be made. A similar adjustable type of bearing is employed for the bottom and top ends of the connecting-rods, and these bearings have been found, we learn, to shorten considerably the time necessary for overhaul and re-adjustment. The crank shaft is forged from the solid. There is a thrust bearing at the forward end and a flange at the generator end, to which the fly-wheel is bolted.

As will be further gathered from the drawing given, the crank case is of box form. It is made in cast iron and is designed to enclose the side shaft with the push rod excentrics, the governor, fuel pump, and rotary distributor drives. Steel tie bolts which pass from the top of the crank case through to the bed-plate bearings are designed to take the tensile stresses, while the compressive stresses are sustained by the cast iron members.

The front of the crank case is furnished, as shown above, with light removable covers which give access to the side shaft and fuel pump and governor drives. At the back of the engine individual crank case doors are provided, which are large enough to permit of easy access to the main bearings and bottom ends.

The cast iron cylinders are attached to the crank case by flanges. They are cast in one piece with the cylinder liners and are made from a special cast iron. A large number of cleaning doors are fitted, giving easy access to the water spaces. A very special design of three-piece pistons is fitted to these engines, the head being of forged steel. The pistons are provided with an extra long skirt and special lubricating arrangements. As shown in our illustration, the pistons are flat topped and they carry five piston rings with two oil scraper rings.

To the right of the drawing, Fig. 4, a section through the cylinder head is given. It is of "one-piece" construction and is bored to take the vertical inlet and exhaust valves and a horizontal starting valve which is placed at the front of the engine. The outstanding feature of the design is the provision of a special shape of combustion chamber exterior to the combustion space in the cylinder and communicating with this space through a restricted neck. There are two fuel valves, which are inclined to each other so that the two sprays impinge upon one another in the centre of the combustion space above the top of the piston. The design is such as to create considerable turbulence, which assists in bringing about very complete combustion. On the trial we noted a clear exhaust with, at times, that faint blue haze which we associate with airless injection engines.

Attention may be directed to the valve gear drive, which comprises excentric-driven push rods which communicate a vertical motion to the roller path mechanism over the valve heads. The claim that this type of drive is quiet in operation was substantiated on the trial runs.

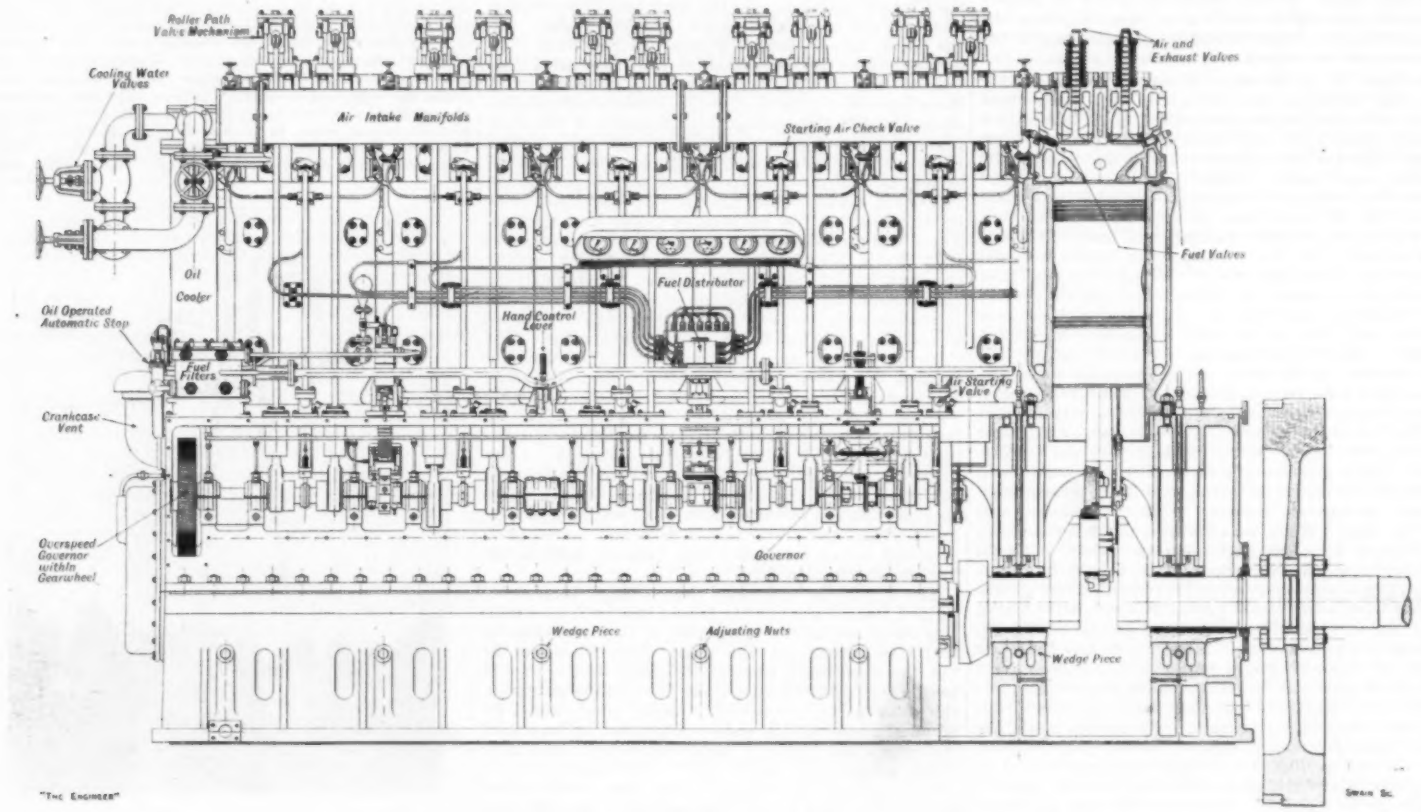


FIG. 4—750 B.H.P. CARELS - INGERSOLL - RAND AIRLESS - INJECTION OIL ENGINE

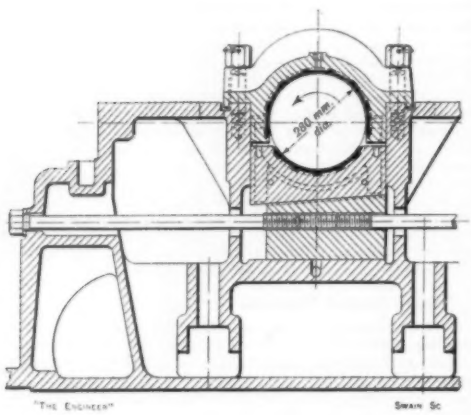


FIG. 5—MAIN BEARING SECTION

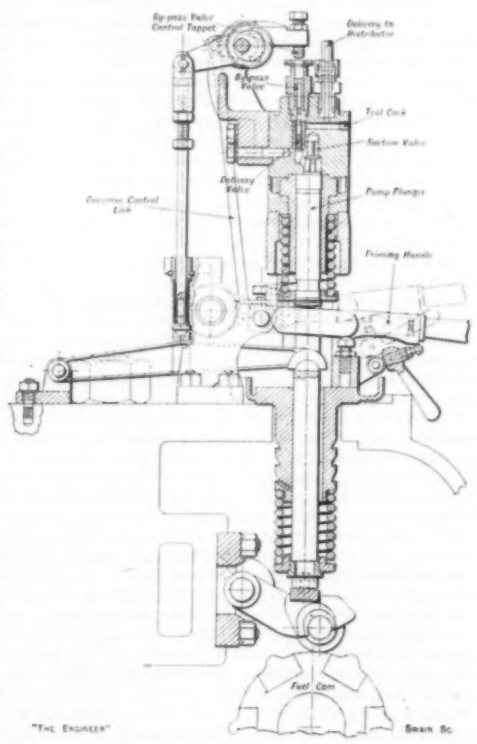


FIG. 6—FUEL PUMP SECTION

* No. I. appeared September 7th.

The exhaust valves are made of a heat-resisting steel with non-corrosive characteristics, and the renewable ring seat of the valve cage is also made of the same material. The exhaust valve cages are water cooled. Special exhaust gas thermometers are fitted at the top of each cylinder.

In Fig. 6 we give a section through the fuel pump, which is driven from the half-speed lay shaft. There is a six-toed fuel cam which gives the pump 675 strokes per minute. From the drawing it will be seen that the lever carries a roller which engages with an intermediate push rod which is spring returned, and in turn operates the spring-returned plunger. The plunger is lapped in the barrel and no packing is required. Both the suction and delivery valves are housed in the upper steel body and there is also a by-pass valve which permits a certain part of the oil delivered by the plunger to be returned to the suction, the fuel pump plunger having a constant stroke at all loads. The by-pass valve is operated by a lever worked through the governor control shaft, which displaces the excentric on which the lever turns.

The governor is of the vertical centrifugal ball type and it is gear driven from the side shaft. On an extension to the main spindle hand speeder gear is provided. Leaving the fuel pump, the oil which is delivered to the engine cylinders passes through a rotary distributor also worked from the side shaft, which is designed to give a very close distribution of fuel at all loads. A hand control lever is provided, which cuts off all fuel from the cylinders by opening to the full the by-pass valve on the fuel pump. We noted that special care had been taken to make all fuel delivery pipes from the distributor of equal length, so that a uniform timing and delivery pressure was maintained at each cylinder. There are two fuel oil filters, which are so arranged that one can be cleaned while the other is in service. Within the gear wheel on the side shaft at the left-hand end of the engine, an overspeed governor is fitted, which, in case of the designed speed being passed, alters the timing of the side shaft and displaces the delivery of fuel, so that at the moment at which it then enters the cylinder the compressor pressure is too low for firing.

It may be stated that the maximum working compression pressure is about 370 lb. per square inch and the final combustion pressure about 575 lb. A conservative M.E.P. rating of round about 63 lb. has been chosen. The guaranteed full load fuel consumption of these engines is 0·41 lb. per B.H.P. hour.

In order to start the engine air is admitted from the starting receiver to the air mains by the operation of a hand-operated opening valve arranged above the crank casing at the forward end of the engine near to the fuel oil filters. The air distributing main connects with the mechanically operated starting valves at the base of the cylinders, while at the top of each cylinder where the air pipe enters there is a non-return valve fitted to check the possibility of back firing into the distributing main.

The lubricating oil is drawn from the sump in the base plate by a pump and is passed through the oil cooler, being delivered under pressure to all parts of the engine. A hand priming pump is fitted and there is a device which automatically cuts off the fuel oil supply in the case of a failure in the lubricating oil system. The cooling water circuit is of the closed type and distant reading thermometers, referred to below, are fitted.

At the front of the engine there is, as shown in Fig. 4, an illuminated gauge board with gauges for the various water, lubricating oil, fuel oil and starting air circuits. Typical readings which we noted during the measured mile runs at Skelmorlie were as follows:—Lubricating oil pressure, 33 lb. per square inch; cooling water pressure, 12 lb. per square inch; temperature of lubricating oil at entry, 80 deg. Fah.; temperature of lubricating oil at exit, 90 deg. Fah.; temperature of cooling water at entry, 60 deg. Fah.; temperature of cooling water at exit, 70 deg. Fah. The readings of the cooling water and lubricating oil circuits are registered on double-pointer gauges. A blue pointer indicates the inlet temperature and a red one the outlet temperature. It is quite easy to note the temperature range from the distance between the two pointers.

The air inlet manifolds and the water-cooled exhaust mains are arranged at either side of the cylinder heads along the front and back of the engine. On the air inlet manifold we noted a particularly neat form of entry and silencing louvre which is arranged at the centre and at the ends of the manifold. The air enters through a stream-lined throat at each corner of the square section manifold, and the arrangement was remarkably silent. The engine is barred round by means of a standard Ingersoll-Rand air motor working expansively, and the backward or forward rotation of the engine is obtained by the movement of a single hand lever. We understand that the application of this widely used form of motive power was first introduced by Mr. Lester Goldsmith, and it is used on all the engines of the Atlantic Refining Company's ships. An interlocking device between the barring gear and the starting air valve is fitted so that the barring pinion cannot be engaged until the valve is open.

Having described the main engines driving the generators, we may now proceed to the switchboard and the auxiliary equipment.

The Main Switchboard.

Fig. 9 reproduced on page 296 shows a view of the main switchboard, which is at main deck level over the engines and comprises eleven panels having an overall length of 30ft. There is one motor control panel and four generator panels—seen to the left of our illustration—which put in or take out from circuit the four generator sets. There are three positions, namely, "Off," "Propulsion circuit," and "Main bus-bars." The four exciter panels are electrically and mechanically interlocked, so that it is not possible to parallel an exciter with the main generators. Fig. 10 shows the interior of the switch-room with the main generator switches to the right, and illustrates clearly the very robust character of the switchgear. A balance panel permits the balancer to be operated from the exciter circuit or from the auxiliary generator circuit. There is a distribution panel for all the auxiliary circuits, which is designed to permit all auxiliary machinery to be worked either from the main power bus-bars or from the exciter bus-bars.

A very complete metering equipment is fitted, and earth detector voltmeters and earth detector lights are provided. A feature of the switchboard design, which was specially brought to our notice, was the arrangement of all live parts within an enclosed room at the back of the swtchboard. There is also a very complete and well-planned series of mechanical interlocks, which are designed so as to prevent any careless handling of the switching arrangements. It is interesting to learn that no electrician or special electrical engineer is carried on any of the nine electrically propelled vessels belonging to the Atlantic Refining Company. The electrical apparatus is in the entire charge of the engineers of the ship, but their only duty, we gather, is to keep it clean. We are informed by Mr. Goldsmith that this policy has been found by the owners to be quite satisfactory.

The Auxiliary Machinery.

For supplying heating steam for accommodation and galley use a multiple-tube vertical boiler built to the owners' design is fitted. It has a heating surface of 630 square feet and works at 25 lb. pressure. A view of the heating boiler equipment is given in Fig. 11. Arrangements are made whereby the exhaust gases from either of the two centre main engines can be passed through the boiler or direct to atmosphere as required. The control valves are of a special disc pattern designed by Mr. Goldsmith, which do not impose back pressure on the engines at any point in the valve travel. When in port a small oil burner of the Howden-Wallsend type is used to heat the boiler when the main engines are not working. The "Mitco" steel ladder treads connecting the main deck plates to the engine-room were supplied by the Hendrick Manufacturing Company, of Carbondale, Pa., and with a mesh of about 4in. by 1in. were very comfortable to walk upon.

As all the auxiliary machinery, both in the engine-room and on deck, is electrically operated, a large number of motors are fitted. They range in size from 1 up to 80 B.H.P. and the total auxiliary horse-power is 550 B.H.P. All the motors are of the standard B.T.H. marine design and several are specially arranged to be interchangeable.

The steering gear is of the "Hastie" four-ram type driven by a 15 B.H.P. motor. As the single drive to this gear has been remarked upon it may be stated that there are three other motors of this particular pattern in different parts of the engine-room. As far as possible all the pumps are of the centrifugal type. Most of them are of the "Jennings" self-priming type and were supplied by the Nash Engineering Company, of Norwalk, U.S.A. They are worked from the 250-volt power circuit, the current for lighting being obtained from a 250 to 125-volt balancer set. The water circulating pumps are three in number and one is driven by a larger motor in order to serve as a fire pump. When at sea two pumps provide all the water required. Other auxiliary pumps include those for the bilge, ballast, sanitary, fresh water, and boiler feed services, as well as fuel oil supply and fuel transfer pumps, some of which are shown in the left of Fig. 7. Beyond these pumps in the same view will be seen the twin-cylinder Ingersoll-Rand 35-kW generator set, the engine for which was supplied by the Rathburn Jones Engineering Company, of Toledo. Ingersoll-Rand air compressors and also a "Reavell" emergency hand compressor are used to supply starting air at 250 lb. pressure for both the main generator and auxiliary generator engines. On the main deck over the engine-room there is a small electrically driven ammonia refrigerating plant made by the Kroeschell Company, of New Brunswick.

Fig. 12 shows the general appearance of the deck of the ship as seen from the bridge aft with the tank hatches and connecting pipes. There is a 12in. main pipe for filling and discharging the cargo, there being five filling positions, each provided with two 6in. bore connections. Within the tanks there is a 10in. main pipe line running both port and starboard for the main tanks and a similar 6in. main for the summer tanks. These pipes extend throughout the cargo tanks. As shown in Fig. 8, the 80 B.H.P. motors which drive the main cargo pumps are placed within the engine-room at the forward bulkhead, the shafts passing into the pump room through stuffing-boxes; the motor drive for a small bilge pump, which is placed in the pump room, is also similarly arranged. Near to the cargo pumps in Fig. 8 the "DeLaval" centrifugal machines for fuel and lubricating oil service will be seen.

The main pump room is just forward of the engine-room and the installation comprises three cargo pumps each designed to discharge 1800 barrels of oil per hour.

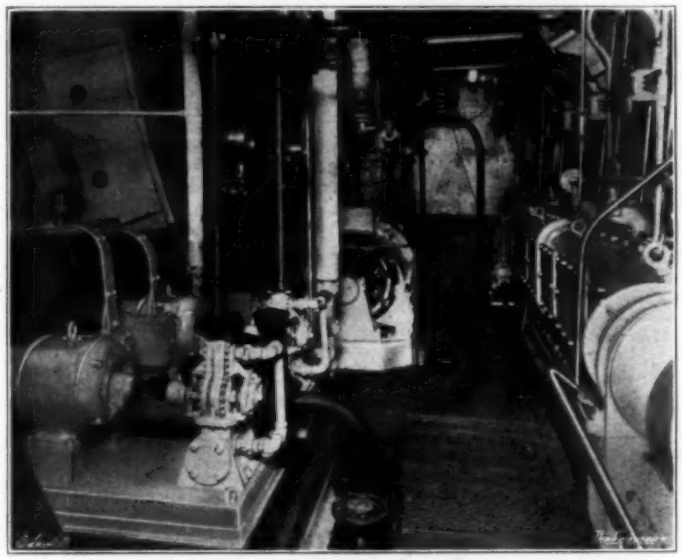


FIG. 7—FUEL OIL PUMPS AND 35 kW AUXILIARY GENERATOR

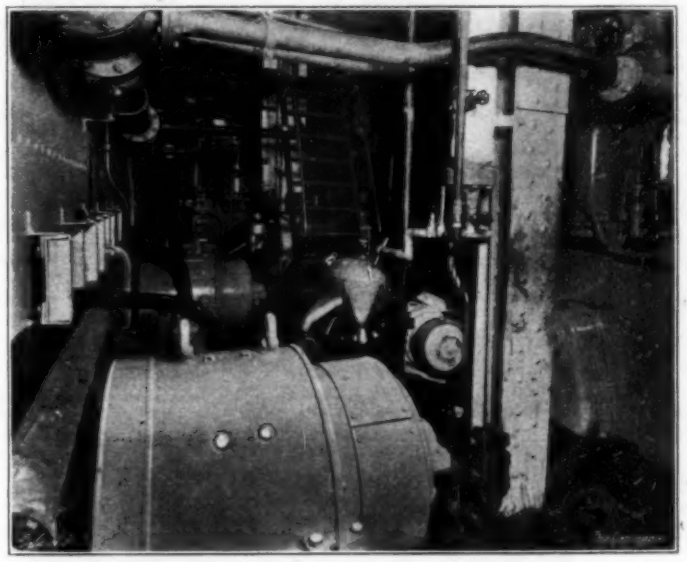


FIG. 8—FORWARD END OF ENGINE ROOM SHOWING CARGO PUMP MOTORS

ELECTRICAL EQUIPMENT ON THE DIESEL-ELECTRIC PROPELLED OIL TANKER BRUNSWICK

THE BRITISH THOMSON-HOUSTON COMPANY, LTD., RUGBY, ENGINEERS

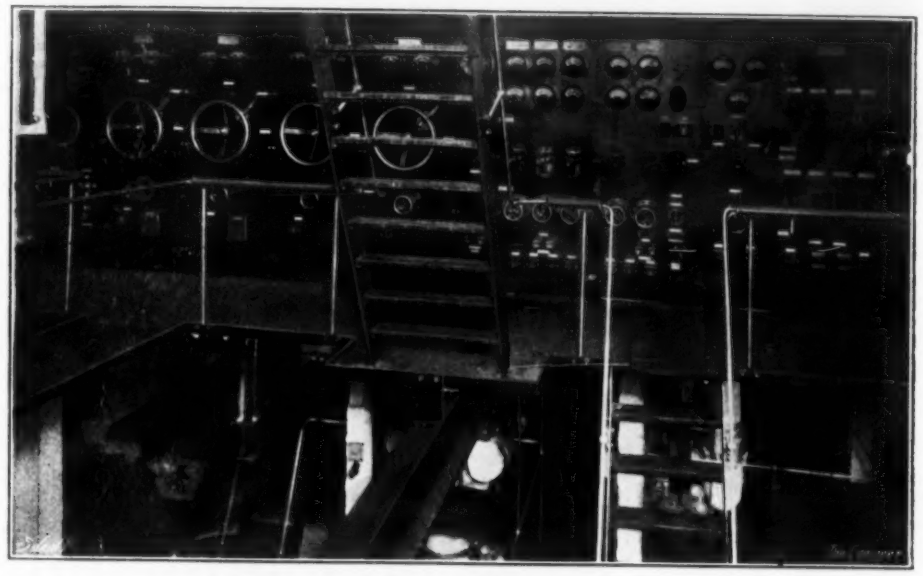


FIG. 9—MAIN SWITCHBOARD GALLERY AT MAIN DECK LEVEL

FIG. 10—VIEW IN SWITCH-ROOM SHOWING MAIN GENERATOR SWITCHES

FIG. 11—THE HEATING BOILER WITH EXHAUST GAS CONTROL VALVES

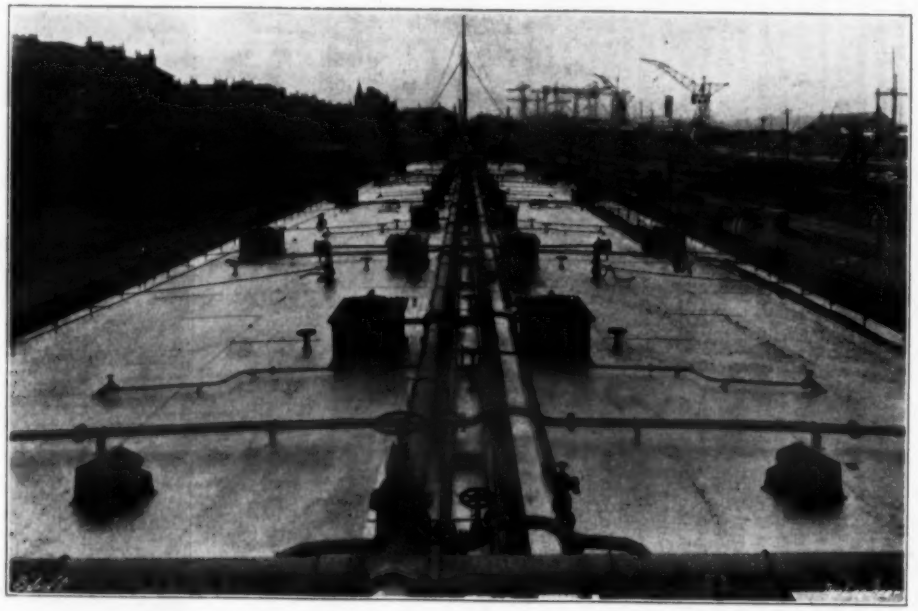


FIG. 12—THE DECK OF THE BRUNSWICK SEEN FROM THE BRIDGE

The pumps are of the rotary type, made by the Northern Fire Apparatus Company, of Minneapolis, U.S.A., and are driven through gearing by the motors above described. Access to the pump room is given by special stairways and ejector arrangements are fitted to the pump room ventilators so that should it be necessary gases can be expelled by this means.

The "Brunswick" is to return to Thameshaven, with her first cargo of light oil, and her performance under service conditions will be awaited with interest.

The Influence of Engineering on Civilisation.*

By Sir WILLIAM ELLIS, G.B.E., D.Eng.

KNOWING that the Engineering Section would be addressed on technical subjects by very distinguished engineers, I have decided to devote my address to speaking of the very extensive part which engineering in its many branches has taken, and is still taking, in connection with the amenities which are associated so closely with our domestic life, and indeed, our happiness. I shall hope in the course of my address to deal in some detail with the fact that each branch of engineering has added its quota to the comfort of our lives, and I think it may be claimed that no other profession has so direct an association with our modern civilisation. The enormous increase in population during the nineteenth century, coupled with the segregation of that population in industrial centres, arising out of the extraordinarily rapid development of industry in this and other countries during that period, has introduced new problems in connection with health and transport, and it has been the task of engineering in its many branches to deal with these problems.

The various branches of engineering I propose to allude to shortly in detail are as follows:—

Civil engineering, as defined above.
Transport.
Shipbuilding, including marine engineering.
Mechanical engineering.
Mining engineering.
Electrical engineering.

CIVIL ENGINEERING.

The point which appears to me to stand out prominently in this branch of the profession is the fact that the structures to be dealt with are in many cases of an enormously costly nature, and have to be carried out with such careful study and comprehension of the varying problems to be dealt with so as to ensure permanent efficiency and safety in the future.

The great reservoirs and harbours of the world may be regarded as the cathedrals of engineering. The varying natural problems to be dealt with involve a very high level of technical education. In the construction of reservoirs, docks and harbours, a considerable knowledge of geology is essential, and in harbour construction the varying effects of tides which have to be studied minutely, have an important influence on the work to be undertaken. Throughout the world will be found monuments to the skill of the civil engineer and the very existence of the population in our large cities in health and comfort is the result of his work, for without an ample and reliable supply of water of good quality, both for personal and industrial use, and an efficient drainage control, our death-rate would indeed be very different from what it is. If we turn for a moment either to India with its great barrage enterprise, or Egypt, with the noble Assouan and Sennaar dams, truly outstanding works of the civil engineer, we find the prosperity of these countries largely resulting from the magnificent irrigation works which have been carried out there.

The large increase in tonnage of ocean-going vessels has resulted in the necessity for larger docks and harbour basins, and the development of railways all over the world, many of them in difficult mountainous countries, has given the civil engineer a great opportunity in designing bridges for carrying this heavy traffic. Many of my audience will appreciate the magnitude of the new bridge over Sydney Harbour now being constructed by British engineers, and the Forth Bridge still holds its own as a masterpiece of British engineering skill, and the construction was in the hands of a Scotch firm well known in Glasgow. The new high-level bridge at Newcastle and the new Mersey tunnel are, I suppose, the most interesting civil engineering works at present in progress of construction in this country, in addition to the considerable dock extensions now proceeding at Southampton, whilst in Canada a very noble bridge is now being thrown across the St. Lawrence River at Montreal.

TRANSPORT.

It may truthfully be said that the development of the potential wealth of any country depends mainly on the means of transport, both personal and industrial. I would allude especially to the great corn-growing countries where the home consumption bears only a small relation to the possible production. The knowledge that there is efficient transport both by rail and for export by sea is the greatest incentive to the farmers to spend money in extensive cultivation with the certainty of a ready market for such production. Without mentioning any countries we probably have instances in our minds where inefficiency of transport facilities is absolutely blocking the progress of internal wealth in those countries. On the other hand, where railways are efficient and harbours well equipped with shipping facilities, we find consequent prosperity.

Railway transport has also made great progress in all measures affecting personal safety and the efficient carrying of our various products. The railway engineers have every reason to be proud of their management of the complex organisation represented by the great railway systems all over the world. We are personally much safer travelling in an express train than we are crossing the streets of a great city, and I think we may justly be satisfied by the fact that in no country do the railways afford more comfortable or more rapid travelling facilities than in our own. The railway engineer has still some very interesting problems to face. Heavier and more powerful locomotives are the natural outcome of the demand for heavier goods trains. The civil engineer of a railway company cannot deal with this problem without strengthening bridges and improving the condition of the permanent way. All these developments involve large capital expenditure, which it is not convenient for many railway companies to undertake at the present time.

The question of the railway companies developing motor services to meet the competition of road transport has been the subject of legislation during the present year. I think the public acquiesce generally in the feeling that as the railway companies pay such a large proportion of the rates of the districts through which they have travelling facilities, it is only right they should develop road transport in connection with their traffic in view of the serious competition which they have to face. Transport by road has undoubtedly been very much facilitated by the large sums which the Ministry of Transport has had available for the purpose of re-making and generally improving our main roads, and careful study has been devoted of late years to the selection of suitable materials for this purpose. Consequently in the last ten years there has been an immense improvement in the quality and design of our main roads, more so than in any previous decade.

NAVAL ARCHITECTURE.

This comprises shipbuilding and marine engineering, and represents a very important part of my subject, dealing, as it does, with the transport by sea and lakes of food and materials, and with the comfort and safety of the many thousands of passengers travelling to and from this country. The wooden vessel in the early part of last century held its own very stubbornly against the introduction of iron or steel vessels, and the mechanically propelled vessel had to fight very hard to oust the very efficient sailing vessels which were then carrying the trade of the world. I imagine that some of my audience with artistic tastes will not be willing to admit that the beauty of the present type of mechanically propelled vessel is comparable with the picturesque five and six-mast sailing vessels which we used to see in our earlier days. This country has undoubtedly been the pioneer in the building of large warships and passenger liners, also in the development of the very large horse-power therefor. The considerable increase in the tonnage of ships brought with it the necessity for a corresponding increase in the mechanical applicanes in connection with their construction. The trial runs carried out before a new ship is taken over by her owners are a severe test of the excellence of workmanship. They are a necessary test to ensure that long voyages of five to six weeks with machinery running continuously at nearly full power can be undertaken without fear of trouble arising from heated bearings or other causes. A new ship may be exposed to such rough weather on her first voyage that unless her plating and riveting are carried out in a first-rate manner, she may arrive in her first port in a damaged condition. Some of us still remember during the war how new ships, built in other countries, were seriously damaged owing to the workmanship not being of a sufficiently good character. The handling of thick plates of large surfaces and the riveting of them satisfactorily to the stanchions still remains a laborious and trying piece of work for those engaged upon it, although mechanical means exist to some extent. Glasgow has taken a leading part providing men who in all weathers and under conditions rendered difficult by the magnitude of modern vessels, maintain the high level of efficiency which is represented in the manufacture of these large hulls. The vessels of the greatest tonnage built on the Clyde have been the "Aquitania" (46,000 tons) and the "Lusitania" (32,500 tons). Other large vessels built in the British Isles have been the "Olympic" (46,439 tons) and the "Mauretania" (30,696 tons). Since the war there has been a lull in the building of liners of large tonnage and horse-power, caused, no doubt, by financial considerations, but it is gratifying to know that two large shipowning companies are at the present time contemplating building vessels up to 1000ft. in length with a speed of over 20 knots.

Shipbuilding is especially interesting, inasmuch as it combines in one structure the varied efforts of almost every class of artisan dealing with both iron and steel and cabinet-making and woodworking generally, in addition, of course, to the large and varied amount of mechanical engineering. In marine engineering the last fifty years have, indeed, a most interesting record of progress, and in very early years such firms as Humphreys Tennant, Maudslay, Son and Field, and other firms no longer in existence, introduced a measure of precision into mechanical engineering probably not then existing in any other branch of the industry. High and low-pressure triple-expansion engines held their own for a considerable period, and it was, I suppose, the interesting trials of the "Turbinia" which brought about the first change from this method. It is an interesting fact that our fellow-member should live to see such successful development of his patent, and a recent paper read by him and his co-workers describes in a very interesting manner the gradual developments and changes in design in turbines up to the present time. Such developments range from the "Turbinia," which had a displacement of 44½ tons with 2100 H.P., to the battle-cruiser "Hood" of 41,200 tons and over 150,000 H.P.

The introduction of geared turbines, so as to arrive at relatively efficient speed as between engine revolutions and propeller revolutions, has brought about valuable economies and helped the turbine principle to maintain its reputation. The development of internal combustion engines for marine purposes has made great strides in recent years. Various types of these engines are already in active service, and a horse-power of 36,000 on four propellers has already been achieved with efficiency; probably the limit has not yet been reached. The use of oil instead of coal on board ship, especially for passenger purposes, represents many advantages, and anyone who has visited the stokehold of a large passenger liner with the hundreds of men stoking with coal must realise the immense advantage, both physical and otherwise, which results from oil burning directly on the boilers. All inconvenience caused by dust in re-coaling is avoided, and the boiler tenting is carried out by young mechanical engineers, doing away with all the labour required by coal burning. In a vessel of large tonnage the saving in wages and maintenance of several hundreds of stokers represents an enormous economy in many directions. The question of larger horse-power and/or electrically driven ships is one of the problems which marine engineers are at present turning their minds to.

A new development which is now being introduced is the use of considerably higher steam pressures in boilers. The first application of this was the "King George V.," a boat built last year on the Clyde, and our section has been favoured with a paper from Mr. Harold Yarrow dealing with some of the problems which have arisen in introducing high pressures. As you will have gathered from his paper, these problem are not solely those of the engineer who has to build the boilers. They are closely associated with steel and metallurgical questions incident to the special manufacture of parts of the boilers, owing to the much greater strength required. Many of my audience, no doubt, have been interested in the valuable information we have received from the paper in question.

The defence of our country depends very largely on the efficiency of our warships, and it is impossible to speak too highly of the wonderful reliability shown by the vessels of our Navy during the late war, thanks to the efficient engineering service in our Navy and the determination of the various builders in this country to produce vessels representing the highest standards of engineering efficiency.

In the mercantile marine we have great cause for thankfulness in the developments which have taken place, resulting in a very much greater comfort at sea. These efforts are naturally limited by the sizes of the harbours between which the vessels have to trade, but when we come to ocean liners the study which naval architecture has given to the production of these great vessels has resulted in our being able to visit different parts of the world with a comfort which is equal to that provided by the best hotels in any of our great cities. Shipbuilding and marine engineering have indeed taken a noble part in assisting the march of civilisation and adding to our comforts in every possible way.

MECHANICAL ENGINEERING.

It is difficult to regard mechanical engineering literally as a separate branch of engineering, for although numerically, I suppose, the mechanical engineers exceed the numbers of any other branch, nearly all their duties are associated with other types of engineering.

In connection with civil engineering all the plant occupied in harbour, dock and railway construction is in the hands of the mechanical engineer. Also in transport and marine engineering the mechanical engineer is largely engaged in the engine building of both locomotives and marine engines and other types of auxiliary machinery for these purposes.

In electrical engineering, although this branch no doubt includes engineers without mechanical training, I would venture to say that the engineer is in an infinitely stronger position if he has received some training first as a mechanical engineer and specialised in electrical engineering afterwards.

A further important branch of the mechanical engi-

* British Association, Section G. Presidential address.—Abridged.

neer's work is represented by the maintenance of machinery in the large steel works throughout the country and in the mills and factories of all descriptions. The directors of these companies are largely dependent on the advice of the engineer-in-charge in giving consideration to developments and the introduction of new types of plant to maintain production on an economic basis.

In mechanical engineering I must include the very important subject of machine tool construction, a branch of engineering which has made very great strides and introduced many changes of design to meet new requirements in the last thirty years. Mass production on an economical basis in many industries has been the direct result of various tool makers being able to produce special tools confined to the production of thousands of identical articles of a complicated design. I refer to articles produced at a cost of one-tenth to one-twentieth of what would be possible without machine tools specially designed for the purpose.

The introduction of high-speed tool steel enabling far heavier cuts to be taken both by lathes and planing machines has rendered obsolete a large quantity of machine tools throughout the country, and the introduction of the electric drive has also brought about great changes in the design of machine tools. We hear to-day of some works in other countries without a single machine tool at work of pre-war date, a most desirable state of things, but one which, unhappily, the economic circumstances in this country have rendered impossible up to the present time. In principle we have to admit that with our relatively high wages and general charges on industry, taxation, &c., it is not economical to continue to use machine tools which can be superseded by modern tools doing a greater volume of work in a given time, but many firms throughout the country are only able to act on this principle gradually owing to financial reasons.

We hear very strong rumours of the advent of a new type of tool steel, if it can be called steel at all, which is going to bring about a greater change in output than was represented by the introduction of high-speed steel some years ago. If this becomes an accomplished fact it is good news for the toolmakers throughout the country, although it may not be equally welcomed by the many large firms already equipped at considerable capital charge with reasonably modern tools.

May I make a suggestion to the toolmakers in this country? When we are putting down an important new machine tool I find the makers will give every possible help in meeting our requirements in design and output, but they rarely follow up and ascertain what the real performance of the tool has been. To many of them "no news is good news." I think this is a mistake on their part. How many improvements and modifications, probably saving their clients money, could be made if they would periodically send the designer or chief draughtsman round to the works where these machines are actually at work and ascertain at first hand from the foreman and even the workman what criticisms they have to make, and accept for careful consideration any suggestions that may be put forward based on personal knowledge of the output of the machine.

Mining Engineering.

In dealing with this section I propose to confine myself to coal mining, so as to shorten what I have to say, and also to be able to apply myself more closely to the development of coal mining as affecting civilisation.

A sufficient supply of coal at a moderate price is a matter of interest to every inhabitant and manufacturer in the country, and therefore any engineering devices which have been introduced to ensure comfort and safety of the miners and at the same time to give us our coal supply for manufacturing and domestic purposes at a moderate price are of interest to everyone. Although we unhappily know that colliery explosions occasionally occur with very dire results, and regret the many accidents to miners arising out of falls of roofs, &c., those of us who are conversant with coal mining matters realise how much science and engineering have done to lessen the risk under which the miners work. I believe that the public feel that one of the great risks is in winding the men up and down the shaft each day, and yet the careful supervision of winding arrangements, inspection of ropes, and general regulations for the safety of the men are such that, so I am informed, it is only one man in forty millions who suffers an accident from this portion of the miner's duty.

The introduction of vertical ropes as guides to the cages, instead of wooden or steel guides, affords a safe and smooth running of the cages at 60 miles an hour with no more vibration than we experience in travelling in an express train at the same speed. Underground haulage has been everywhere adopted, so that the use of men for this arduous work, and, to a great extent, ponies also, has been abandoned. This underground haulage is largely carried out by compressed air engines placed underground, as in many pits it has not been felt safe to introduce electric power for the purpose except in the immediate neighbourhood of the shafts. It is true that the electrical engineer has gone a long way in lessening the liability to sparking, and in enclosing the motors so as further to lessen this risk. We are still left, however, with possible danger caused by the cables along the main roads, which, however carefully placed, are still liable to be damaged by unexpected falls of roof, thereby introducing a potential danger which is difficult to eliminate. At the coal face the engineer up to the present has not been able to do much to lessen the hard manual labour of the working miner, but in thin seams, say, up to 3ft. thick, where manual work on a solid face would be almost impossible, coal-cutting machinery, in which a well-known firm in this city has successfully specialised, has been introduced, thereby lessening enormously the manual work of the miner. I venture the opinon that the introduction of machinery for this purpose has not yet reached its limit.

Electrical Engineering.

This branch of engineering covers a very wide range of subjects and affects our social life almost more intimately than any other type of engineering, except perhaps the supply of good water and efficient drainage installations. It is impossible for me to attempt to cover the whole range of subjects embraced in electrical engineering. Telegraphy, telephony, wireless, electric lighting, electric heating, electric driving, and electric power in their various ranges all enter into and affect the comfort of our domestic life.

The development of electricity as a mechanical driving power was very slow up to a certain date. For instance, I went by electric train from Berlin to Charlottenburg in the spring of 1882. The running of the railway appeared to be quite satisfactory, and yet it was at least ten, and I think fifteen, years before any real development took place in the way of electric railways or trams, the difficulty, I believe, being in producing satisfactory dynamos on an economic basis. The first electric railways in this country, so far as I know, were the Liverpool Overhead Railway in February, 1893, and the Liverpool to Southport Railway in April, 1904. The practicability of electric driving on main lines is still a matter under discussion. The only country which has wholeheartedly adopted this system is Switzerland, a country which has undoubtedly been influenced by the uncertainty of obtaining a uniform supply of coal at reasonable prices, coupled with the fact of an efficient and ample supply of water power for their generating stations. The Barberine Reservoir, which has now been completed, and the large reservoir at the Grimsel Hospice now under construction, are fine examples of civil engineering work carried out for the purpose of developing electric current for the Swiss railways.

In this country considerable developments are taking place on the various main lines, but engineers are at present concentrating on the use of electric driving mainly for suburban traffic, and not at present on main line long-distance expresses. It is probable that the great extension of high power installations throughout the country contemplated by the electricity commissioners will render possible a more extensive use of electric trains on our main lines.

The application of electricity for driving purposes in the various large works in this country made very rapid strides as soon as electrical machinery for the purpose was available. I remember showing to a former President of this Association, Sir William White, the first set of Belliss and Morcom engines we had installed in a works in the Midlands, the various machines in these works at that time being driven by steam engines in different shops and line shafting. Sir William said to me then, "Do you realise that within ten years every machine in these works will be electrically driven?" I think few engineers realised at that time that electric driving would replace so rapidly the existing methods. Apart from the economy represented by its introduction, the change enables the management to register the amount of power used by each type of machine under varying loads of service, a circumstance which was impossible with belt-driven machines, when the power varied according to the tightness and width of the belt. The greater efficiency, however, is really represented by the fact that in a large works electricity can be produced in bulk at a central power station at a low rate of cost, and the loss in distributing to the various departments through high-tension cables and transformers to lower voltage in the different sections of the works is insignificant compared with the saving represented by a consumption of coal and a cost of maintenance far below what is possible with direct steam driving. Electricity has in some measure been introduced into mining engineering, as I have mentioned in the mining section, electric winding engines have been adopted with satisfactory results. but as the fuel supply for steam raising at the various collieries, especially where coke ovens are installed, is much less costly for providing power than in a works without such auxiliary facilities, the economy in the use of electric winding *versus* steam is naturally not so great.

The public, I think, fails to realise that electric lighting for domestic purposes, if charged at a reasonable rate, does not represent any real charge on the household. It is so clean in its application that, in my opinion, the necessity for cleaning and decorating which is avoided in many cases represents a greater saving than the amount paid for electric light. In addition, we have the great advantage that it does not burn oxygen, and therefore we have more healthy conditions in our rooms compared with any other method of lighting.

Conclusion.

Since I roughed out this address it has been my privilege to make a journey across America from New York to the Pacific Coast, and return through the Rocky Mountains and Canada, and throughout my journey I could not help realising how large a share engineering in its broadest sense has taken in developing these wide regions. First comes the railway as a through communication between east and west for 3000 miles. Gradually settlers come and farming and lumber work commences, their progress only being possible with the aid of railway transport. Gradually small towns spring up requiring the assistance of engineers for water and drainage. In the torrid provinces of New Mexico and Arizona the water question is a very serious one, and large irrigation schemes will have to be introduced. At Grand Canyon, for instance, the water for household and farm use is brought nearly 200 miles by train in large special wagons. Then mineral wealth is discovered, and the mining engineer appears and requires his varied plant to be brought by railway from the manufacturing centre. In the mountainous parts of the country large hydro-electric plants are being developed, thus calling on the electrical engineer for his services, and I might quote many other illustrations of a similar nature.

Yes, ladies and gentlemen, those of us who are spending our lives in engineering work may justly be proud of the large share the members of our profession are taking in promoting and advancing the civilisation of the world, and thereby bringing happiness and prosperity to many thousands of our fellow countrymen.

I realise that within the limits of this address I have only been able to touch to a very limited extent on the association of the different branches of engineering as affecting our civilisation. I hope, however, I have said enough to interest my audience in a side of engineering that is not often brought out, and that those of us who are actively engaged in engineering may earn the respect and confidence of our fellow citizens.

A Summer School of Engineering.

THE nearest approach to a "summer school" of engineering hitherto has been in the form of summer meetings of the different engineering societies, but these are tending more and more to become friendly reunions devoted chiefly to sightseeing and other light forms of entertainment. Moreover, not all professors and lecturers are members of these societies, and even those who are have not always the time to spare or are otherwise prevented from attending these annual meetings. We have heard, of course, of summer schools in connection with politics, and also for certain branches of the teaching profession, but it has been left to an enterprising engineering firm to organise the first real "summer school" for professors and lecturers in engineering at our Universities and technical colleges. The rendezvous is Trafford Park, and the Metropolitan-Vickers Electrical Company, Ltd., is the host and provides the "teaching staff." That the "school" is appreciated is shown by the remarkable attendance of representatives from all the principal seats of learning in England, Scotland, Ireland, Wales, and even from Tasmania. There are, of course, few engineering firms in Great Britain that are capable of such a scheme as this, involving as it does nearly a week's entertainment of the "scholars," and a full programme devoted to discussions and lectures on various topics, both technical and administrative. There are fewer still that take such exceptional interest in the educational side of engineering and collaborate so freely with the engineering schools and universities. The "Metrovick" Company provides facilities under the control of its education department for the training of apprentices under two grades, one for artizan employment and the other for training for professional employment, and there were many amongst those present at the "summer school" this week who had obtained an important part of their technical education at these works. To them the visit must have been doubly attractive, for the company has made great strides in recent years, and there have been many extensions of the works which were viewed for the first time. The new switchboard erecting shop of huge proportions was greatly admired, with its floor plates for erection purposes and the system of jigs for use by the fitters. Some remarkably heavy work for the Victoria Falls Power scheme, including circuit breakers up to 132,000 volts capacity, were inspected with peculiar interest, after hearing what Mr. W. A. Coates had to say in a lecture on "Switch-gear Design." Some remarkably fine examples of high voltage metal-clad switch-gear units, with circuit breakers and duplicate bus-bars, were also open to inspection.

The "school" assembled on Monday last and will conclude to-day, Friday. The proceedings on Monday opened with a reception in the Company's Research Department Conference Room, after which the "scholars" were entertained to luncheon, and were welcomed by Mr. A. P. M. Fleming, C.B.E., M. Inst. C.E., special director. Then followed a tour of the works, when the visitors were placed in charge of ex-students of their respective Universities or colleges—a happy idea and one in which the relative positions of teacher and pupil were reversed. Dinner served in the works canteen was followed by a lighter form of entertainment at neighbouring baths, in which the apprentices displayed their prowess in swimming.

On the following days the proceedings were of a more strenuous description. Each day opened with a paper or lecture by experts in the employ of the firm. On Tuesday, for instance, there was a paper on "Switch-gear Design,"

by Mr. W. A. Coates, M.I.E.E., to which we have referred already. In the afternoon the members of the "school" were received and took tea with the Lord Mayor of Manchester, and to fill in the remainder of a long but varied day's proceedings—which started at 9 a.m.—a discussion took place on "The Engineering Graduate in Industry." Starting at 9 a.m. on Wednesday and Thursday two papers were given, one in the morning and one in the afternoon. Here the "scholars" interested particularly in the design of motors had an insight into "Large Machine Design," by Mr. R. Townend, A.M.I.E.E., and "Motor Design," by Mr. R. Johnson, M.I.E.E.; and on Thursday papers were read on "Turbines and Condensers," by Mr. K. Baumann and Mr. H. L. Guy, M.I. Mech. E.; and "Electric Traction," by Mr. R. Brooks. A.M.I.E.E.

To-day, Friday, the programme will be opened with a paper by Mr. A. P. M. Fleming, in which he will outline the promoters' research policy and demonstrations will be given in the research laboratories. In the afternoon a visit will be paid to Barton Power Station, and a very full five days' proceedings will come to a fitting end with a dinner, which will be presided over by Sir Philip A. M. Nash, K.C.M.G., C.B., chairman of the Metropolitan-Vickers Company.

Visits such as these cannot fail to prove of inestimable benefit to all concerned. They bring together for mutual benefit those responsible for the technical training of the young engineer and those responsible for his practical training and future employment. Over and above this, they enable the members of the teaching profession to get an insight into the latest engineering practice in different branches. By their attendance in such large numbers at Manchester the teachers have shown that they are willing to avail themselves of these opportunities, and it is to be hoped that such meetings will be repeated in other centres.

AMERICAN SHIPPING POLICY.

IN shipping circles it is generally considered that the new Jones-White law will aid greatly in building up the American merchant marine, and steps have already been taken to secure contracts for carrying the United States mails and for obtaining the Government loans which, under the new law, may be made to private concerns to assist in the construction of new vessels and the operation of new lines. Orders are already in sight for the construction of large vessels in American shipyards. The widespread effect of this policy has been shown by a statement indicating the varied supplies entering into ship construction and the large proportion of cost paid for labour. Thus, in the shipyard itself about 39 per cent. of the expenditure is for labour, while in the steel industry furnishing raw materials and steel products the percentage is about 79 per cent. As a net result, in the case of a large Transatlantic liner costing £3,000,000, about 78 per cent. of this cost would go to labour in the shipyard and in allied industries. An analysis of the value of material in a 10,000 freight steamer shows about £147,000 for material purchased directly by the shipbuilding concern from outside firms. The items include:—Rolled steel and rivets, £40,300; cast steel, £4600; cast iron, £7700; forgings, £7200; cast and sheet brass, £7600; pipe, valves and fittings, £4100; brass and copper wire, £3200; wire rope, £1000; generators, £3000; boilers, £22,000; engine-room auxiliaries, £12,000; deck machinery, £18,000. On the other hand, wage rates for labour in America average about double those of shipyard labour in England. In fact, the rate for even common labour in the former is higher than that for the most highly skilled labour in the latter. In general, however, the present situation is decidedly encouraging for the development of American shipbuilding and shipping.

LAUNCHES AND TRIAL TRIPS.

ISLEWORTH, steamer; built by Cowpen Dry Docks and Shipbuilding Company, Ltd., Blyth, to the order of Mr. R. S. Dalgliesh, Newcastle-on-Tyne; dimensions, 415ft. by 54ft. by 29ft.; 8400 tons on a draught of 24ft. 10in. Engines, triple-expansion, 27in., 44½in., 73in. by 48in. stroke; constructed by Blair and Co. (1926), Ltd., Stockton-on-Tees; launch, August 30th.

OPHIR, twin-screw motor ship; built by Nederlandsche Scheepsbouw Maatschappij, to the order of Koninklijke Paketvaart-Maatschappij; dimensions, length, 386ft. 6in.; breadth, 51ft. 6in.; depth, 23ft.; displacement, 7200 tons. Engines, two eight-cylinder, single-acting, four-cycle Diesel; launch, September 1st.

CARONI RIVER, motor vessel; built by Blythswood Shipbuilding Company, Ltd., to the order of the British Empire Steam Navigation Company, Ltd.; dimensions, 460ft. long, 59ft. broad, and 33ft. 9in. deep; 11,000 tons deadweight. Engines, single-acting Diesel; constructed by J. G. Kincaid and Co., Ltd.; launch, September 3rd.

LAVIAN, single-screw steamer; built by Barclay, Curle and Co., Ltd.; to the order of the African and Eastern Trade Corporation, Ltd.; dimensions, 340ft. long, 48ft. beam, and 30ft. deep; 4800 tons deadweight. Engines, triple-expansion, 22in., 37½in., 63in. by 45in. stroke, pressure 210 lb. per square inch; launch, September 3rd.

OILPIONEER, single-screw motor tanker; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British Oil Shipping Company, Ltd.; dimensions, length, 424ft.; breadth, 53ft. 5in.; about 8500 tons of oil cargo. Engines, seven-cylinder Neptune Polar Diesel; launch, September 3rd.

BRITISH THRIFT, motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British Tanker Company, Ltd.; dimensions, length, 195ft.; beam, 31ft. 6in.; oil in bulk. Engines, Neptune Polar Diesel, 420 mm. bore by 720 mm. stroke; trial trip, September 4th.

LADY DRAKE, steamship; built by Cammell Laird and Co., Ltd.; to the order of the Canadian National (West Indies) Steamships, Ltd.; dimensions, length 437ft. 3in., breadth 59ft., depth 31ft. Engines, two sets of single reduction geared turbines; launch, September 4th.

BURDWAN, single-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of the Hain Steamship Company, Ltd.; dimensions, 435ft. long, 57ft. 4in. broad, and 32ft. 3in. deep; deadweight carrying capacity 9400 tons. Engines, quadruple-expansion, 30½in., 44in., 63½in., and 91in. diameter by 57in. stroke, pressure 230 lb. per square inch; trial trip, September 5th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Growing Demand.

THE improvement noted last week in the iron and steel industries in this district is maintained, and there are several encouraging features which sustain makers in their belief that the autumn demand is developing. The heavy industries of the Midlands and Staffordshire are beginning to show greater activity, and the volume of business should steadily increase with the autumn. The mills and forges have fair orders for the time of the year, though requirements are mostly on the small side. Fewer orders are being placed abroad, and there is reported to be an inclination on the part of some consumers to negotiate in view of actual and prospective requirements. At the weekly meeting of the iron trade in Birmingham the market tone was bright, and producers and consumers alike showed signs of returning confidence in the ability of trade to re-establish itself.

Pig Iron Situation.

Progress towards a more healthy state of trading continues to be made in the Midland pig iron industry. Buying shows further improvement this week, and it is the considered opinion of at least one well-known authority that consumption is now equal to, if not in excess of, the output of Midland blast-furnaces. There are, of course, the accumulated stocks to be reckoned with, but these are now being drawn upon. Until they are substantially reduced, however, there is little possibility of smelters securing any marked advance in prices, though present selling rates are held to be unremunerative. Consumers are watching the position very closely, and at the moment they do not see the necessity for placing forward contracts. They continue to buy sufficient material to satisfy immediate needs, but no more. Orders are none the less increasing in number and this week there has been renewed inquiry regarding forge quality irons. Prospective buyers do not regard the prices asked as acceptable, and in most cases business was withheld. Midland foundrymen on 'Change in Birmingham to-day—Thursday—discovered that Derbyshire blast-furnacemen were firm in their attitude to prices. Offers of orders at below the quoted rates were turned down. Sellers wanted at least £2 19s. for No. 3 foundry material and £2 16s. for forge. Northamptonshire smelters dispayed a little less firmness and quotations were not uniform. The market level, however, was about £2 15s. 6d. to £2 16s. 6d. for foundry and £2 13s. 6d. for forge.

Steel.

The stronger competitive position of native steel works on account of increased production costs in Germany remains an important factor in the steel situation. Continental prices maintain an upward tendency, so that for a considerable range of products they cannot now effectually compete for the British markets, at all events in the Midlands. Consumers of both finished and semi-finished material are placing their orders with Midland firms whose position, as a result, is gradually improving. Good quantities of steel are being absorbed by constructional engineers in this district in the erection of commercial premises in and around Birmingham. It is claimed that the bulk of this is native material. Home railways are showing some enterprise in the reconstruction of stations and electrification schemes, and further orders for rolling stock are expected to come from the Colonies. Rolling mills have a miscellaneous programme necessitating a good deal of roll changing and a certain limitation of output. There is no change in prices of finished material, and it is not considered likely that any will be declared at the meeting of the Steel Association this month. Considerable prominence is almost bound to be given at this meeting to the steel rebate scheme, which has now been in operation for twelve months. How far it has succeeded in its object of defeating foreign competition in heavy steel it is difficult to determine. There is little enough on which outsiders can form a judgment. There can be no doubt but that valuable experience has been gained during the past year's working of the scheme, which will be turned to account if it is deemed worth while to continue the experiment. Nothing has occurred as yet which suggests a change of policy on the part of the Association, and from what has been stated as to the success of the scheme there is no reason to anticipate its abandonment. Makers of billets and bars maintain their firmer quotations, and as there is no appearance of an easing of the continental situation users are becoming more and more inclined to purchase native material. In some cases they are forced to do so to secure material with which to carry on. Small bars range from £7 7s. 6d. upwards of £8. Billets sell at £6 2s. 6d. upwards. Steel scrap continues firm at £3 7s. 6d. delivered South Wales. Heavy steel turnings realise £3.

Staffordshire Iron.

Staffordshire ironmasters' report little, if any, change in the general position in the industry on the week. Orders are being received in sufficient quantity to keep the mills running, but a considerably greater bulk of work is necessary to ensure regular rolling. Sales are of relatively small tonnage and values are unchanged. Marked bars make £12 per ton, crown quality bars range from £9 2s. 6d. to £10, and nut and bolt and fencing bars are obtainable at from £8 15s. to £9. An increasng amount of the latter iron is selling, but consumers, hoping for improvement in the continental situation, give out business cautiously. They seem determined to buy in the cheapest market, but as deliveries of Belgian material are somewhat belated they are satisfying immediate needs from local works. Wrought iron tube strip makes £10 15s. to £10 17s. 6d. Tube makers in this district are fairly well employed and are absorbing considerable quantities of strip.

Galvanised Sheet Values.

Better orders and increased inquiries have been received by galvanised sheet mills in this district and manufacturers are advancing their quotations above the Association basis of £13 7s. 6d. for 24-gauge. In some cases £13 12s. 6d. and even £13 15s. is asked, but £13 10s. is the more general quotation. Some good inquiries have been received both on home and foreign account. South America and India have provided some excellent orders, and many of the mills have now from four to eight weeks' work in hand. Under these circumstances it is not surprising that producers are indisposed to accept recent price levels. It is reported that Birmingham merchants, owing to the further upward tendency of the continental market, are not able to sell much material.

Tin-plate.

The stimulus which the tin-plate industry has received is not reinforced in this district. A premium of 1¼d. to 3d. is asked on the basis of 18s. for primes. Wasters are in little demand here, though they are based on 16s. 9d.

Good Orders for Midland Firms.

The Metropolitan Carriage, Wagon and Finance Company, Ltd., of Birmingham, has secured an order for the South African Railway and Harbour Administration for the supply, through the Vickers and Metropolitan Carriage (S.A.), Ltd., of Johannesburg, of 500 four-wheeled open, drop-sided and steel wagons, at £200 per wagon f.o.b. Liverpool. Another acceptable contract is one for three 100 horse-power special type six-wheeled locomotives for the 2ft. 6in. gauge lines of the Bombay, Baroda and Central India Railway, which has come to the Sentinel Wagon Works, Ltd., of Shrewsbury and Westminster.

Warwickshire Miners' Wages.

Further developments have taken place in the difficult situation which has developed in the Warwickshire coalfield in regard to wages, to which I gave prominence in my letter of August 31st. The notices terminating all engagements under the 1926 wage agreement of Warwickshire, posted at six Warwickshire collieries, terminated during the week-end. The Tamworth Colliery, which was one of the group, has made its claim to the Joint Wages Board and this has resulted in an 11 per cent. reduction on the 1911 basis (which was 43 per cent. as a minimum). Until the next meeting of the Joint Wages Board work at the five pits—Pooley Hall, Exhall, Newdigate, Keresley, and Binley—are continuing on a day-to-day agreement at present wages. The five pits have made a joint application to the Wages Board for a reduction in the present minimum, and the matter will come before a meeting of the Board this week.

Automobile Engineering.

Coventry, Birmingham and Wolverhampton motor car engineering firms are now entering upon another season. Though there are many difficulties yet to be overcome, the industry as a whole is re-starting with renewed hopes. Certain firms which have emerged successfully from what for most has been as exceedingly anxious time have arranged for greatly extended programmes for the season 1929 and are well advanced with their preparations. It is satisfactory to learn that in the case of some of the best-known Coventry firms order books are well filled for the new models and these firms will get on to production quickly.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Bridge Widening Scheme in the Balance.

THE joint Manchester and Salford scheme to reconstruct Blackfriars Bridge which crosses the river Irwell at the boundary of the two cities and to widen Blackfriars-street at an estimated cost of £194,905, after allowing for promised grants from the Ministry of Transport, amounting to £60,895 and proceeds from the sale of land estimated at £154,200, was considered at the last meeting of the Salford City Council, but after a good deal of discussion, was referred back for consideration at the next meeting of the Council. Whether or not the scheme will be accepted is doubtful, for it became apparent from the Council debate that opposition to it on various grounds is particularly strong. One complaint was that whilst Manchester would derive the greater benefit from such a scheme rather more than two-thirds of the cost would fall on Salford. The scheme, it may be recalled, has been the subject of protracted negotiations between two special committees of the Manchester and Salford City Councils.

More Electrical Plant for Salford.

A recommendation of Salford Electricity Committee that application should be made to the Electricity Commissioners for permission to borrow the sum of £15,000 to meet the cost of installing at the Trafford Park substation a 33,000 volt step-down transformer has been adopted by the City Council, who also confirmed the action of the Committee in accepting the tender of Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park, Manchester, for the supply and erection of a 16,000–20,000 kW turbo-alternator set with condensing plant at the Agecroft Power Station at a cost of £50,841. Later, an attempt was made by certain members of the City Council to pass a resolution of protest against the recent placing of a Government contract for telephone wire with a French firm, but general interest was not sufficient to attract the necessary quorum, and the subject was dropped.

Textile Machinery Safeguards.

Additional safeguards for the prevention of accidents arising from machinery in cotton mills have been

devised by the joint efforts of the organisations representing employers and operatives, and a statement embodying rules for the fencing of such machinery has just been issued from the Manchester headquarters of the Federation of Master Cotton Spinners' Associations. It is officially observed that the revised agreement, except for a number of additions, is to a great extent identical with the one adopted in 1912. Additional safeguards are now required on new machines of certain classes, including opening machinery, speed frames, and ring frames, whilst additions have also been made to the list of specific parts of existing machinery for which fencing was required under the earlier agreement. For the prevention of accidents to persons engaged between the fixed and traversing parts of self-acting mules, a standard system of stopping and starting the mules and signalling to the operative before he enters the space for the purpose of cleaning has now been prescribed.

Machine Tool Makers' Profits.

In their annual report for the financial year ending June, the directors of the machine-tool making firm of Kendall and Gent (1920), Ltd., of Gorton, Manchester, put out that although the first half of the year's trading showed no improvement over the previous year, due to the fact that the year covered by the report opened with a poor order book and under very depressed conditions, the final trading result is a profit of £2889, against the previous year's loss of £3379, or an improvement of £6268. After allowing for debenture and loan interest and other charges, there is a net loss of £539, which increases the debit balance forward to £51,279. The directors express the opinion that the outlook is better than it has been for several years past, and add that the orders on the firm's books at the close of the financial year represented an appreciable improvement compared with twelve months previously.

Non-ferrous Metals.

All sections of the non-ferrous metals market during the past week are lower on balance than at last report but, except in the case of tin, the declines have all been of limited extent, and may be regarded as minor day-to-day fluctuations. In respect of tin, however, the fall has been fairly substantial, and has been more than sufficient, at all events, to wipe out the advance registered a week ago. In passing, it may be worth mentioning that the tin prices current at the moment of writing closely approximate to the low levels ruling early in July. The reaction in this section of the market is due less to any change of sentiment, for the renewed "bullish" interest in the statistical position of tin seems to be maintained, than to the fact that certain important buying interests in America are reported to have been holding off the market. Copper is fractionally cheaper on balance, but the undertone is undoubtedly strong. Consumers are taking fair quantities and sellers are basing a good deal of hope upon what are regarded as favourable prospects for a continued heavy consumption. After the sharp rise reported last week lead has suffered a reaction, although an important part of the gain has been held. Both consumers and speculative interests have been fairly heavy buyers of late. Spelter has only been in moderate request, but the loss in values on the week has been very small.

Iron and Steel.

Although there has been no appreciable improvement in actual business in iron and steel this week, the outlook appears to be brightening a little. So far as pig iron is concerned, a good many foundries in this part of the country have allowed stocks to get down to a very low level, and there is growing confidence among sellers of the metal that before long consumers will be compelled to come into the market. Judging from the views expressed this week a slight strengthening of prices is more likely than any further weakening. If this opinion turns out to be correct, the buying process is likely to be accelerated. Offers of business during the past few days have been somewhat limited in extent, but quotations for all grades of pig iron have been maintained. For delivery Manchester or equal, Derbyshire No. 3 is steady at about 67s. 6d. per ton; Staffordshire at 67s.; Middlesbrough at 79s.; Scotch at 87s. 6d. to 90s.; and hematite at about 81s. 6d. Bar iron meets with a rather slow inquiry, but at £10 per ton for Crown quality and £9 10s. for seconds there has been no alteration in Lancashire Association prices. With regard to steel, although constructional engineers in this area continue to be fairly well engaged, the lull in new inquiries of any importance continues. They are still, however, buying in regular quantities, and in some cases talk of a possible firming up in steel prices is attracting attention to forwards buying. Prices remain steady, with sections and joists quoted at £7 17s. 6d. per ton; general plates at £8 12s. 6d.; and frame plates at a 5s. premium; boiler-plates at £9 12s. 6d. to £9 17s. 6d., according to quality, and large steel bars at £8 17s. 6d. Re-rolled bars are a shade dearer, with current quotations for these at from £7 15s. to £8 per ton. Rather more activity than of late has been in evidence in imported finished steels, with semi-manufactured products dull on extreme scarcity of supplies. Quotations are very firm in all sections, with about £6 17s. 6d. per ton quoted for angles; £7 2s. 6d. for steel bars; £6 5s. for joists; £6 17s. 6d. for wire rods; £5 15s. for sheet bars; and £7 to £7 2s. 6d. for bar iron, for cash against documents and including delivery to works in the Lancashire district.

BARROW-IN-FURNESS.

Hematite.

There is a slightly better tone in the hematite pig iron market, which is not due to the present demand but more to the fact that inquiries tend to show that there is some likelihood of better trade in a month or two. At the moment the deliveries are for customers' immediate requirements, and the tonnage is not much better than it has been for some months. The steel departments at Barrow are still taking a substantial amount of iron, but in Cumberland owing to certain stoppages less is required. Special classes of iron are in moderate demand, but the amo unt of trade overseas in this respect is quiet. In ordinary qualities of iron the continental and American trade is dull. The iron ore trade continues to be the same, and there will be no change in the demand until better business requires more furnaces. The business outside the district continues moderate. Foreign ore imports are fairly restricted to present requirements. The steel trade remains quiet, and the Cumberland mills are now only engaged on sleepers. At Barrow, apart from the hoop mills, there are contracts held which will keep the rail and merchant mills engaged until the end of October. Further orders are required to keep the mills going after that date.

SHEFFIELD.

(From our own Correspondent.)

The Steel Trade Position.

THERE is a good volume of work on hand in Sheffield and district, and a feeling of hopefulness prevails in relation to the winter trade. The basic steel side is stronger than it has been for many years. Belgian and French competition has fallen off since the rise in prices in those countries, and steel rollers are now able to buy home-produced billets of better quality than the foreign at nearly the same rates. A good sign for the future is the re-starting of a blast-furnace at the Redbourne Hill Works, Lincolnshire, and the further news that two steel furnaces are being prepared for operation early in December. The demand for best acid qualities of steel continues poor, and gives no actual evidence of early improvement, although the railway steel plants are expecting larger specifications from the home companies during the next few months. Rolling mill firms report that their business is mainly for small lots, but it has not shown any falling off lately. Some price cutting is reported in certain of the alloys of special steels, owing to the poor demand.

Spanish Duty on Files.

The saw and file branches are slack, but show a somewhat better tendency. A good deal of anxiety has been caused in Sheffield by the report, received by a well-known firm from their principal representative, that Spain intends to impose a largely increased duty on files. The report is that, as from January 1st next, the duty will be raised from 56 to 250 pesetas per 100 kilos., which means that on files of 12in. and upwards there will be an increase of about 40 per cent. The firm's representative says that "something will have to be done by Great Britain, otherwise our share of the file trade will be much less than at present." The Secretary of the Sheffield Chamber of Commerce states that the whole matter of Spanish duties on Sheffield products has been occupying the attention of the Chamber for the past year. Responsible Spanish officials have been interviewed and endeavours have been made to bring about certain revisions of the classification which at present operate to the detriment of certain classes of Sheffield steel. "In certain grades of steel," he adds, "the Spanish Government is acceding to the suggestions that have been put forward for the change in the classifications. We do not anticipate that we shall be so successful with regard to the actual revision of duty on other commodities which may be increased."

An Up-to-date Performance.

Samuel Osborn and Co., Ltd., another well-known Sheffield firm of high-speed steel makers, have published some details of new steel which, in the words of Mr. F. A. Hurst, one of their directors, "has made the earlier high-speed steels quite a back number." The steel is being demonstrated at the Olympia Exhibition, "where," says Mr. Hurst, "we are cutting a 30-tons tensile steel shaft at a speed of 270ft. a minute with a depth of cut of $^{9}/_{16}$in. and a traverse of $^{1}/_{25}$in. Further, this new material, which is S.O.B.V. cutting alloy, is capable of machining manganese steel, a material hitherto unmachineable, and has made possible the cutting of the hardest chilled cast iron at speeds never before obtainable."

Another Colliery Closing.

There have been several serious effects of the coal trade depression in this district, but none more serious than the decision of John Brown and Co., Ltd., to close down their Rotherham Main Colliery. Over 2000 men are affected. The pit dates from 1892 and has been extended from time to time. It is up to date in all respects and has provided fairly continuous employment. In issuing notices to the workpeople the firm state that "it is a well-known fact that the geological conditions at Rotherham Main Colliery are such that the colliery can only prosper when the coal trade is in a normal condition. The present serious depression in the industry makes it impossible to carry on, and it is only after working at a serious financial loss for some considerable time and giving the matter much careful thought that the directors have reluctantly decided that the working of the colliery must cease."

Sheffield's Electrical Supremacy.

The Sheffield Municipal Electricity Department has decided to revert to the pre-war scale of charges, by sweeping away the last of the percentage increases which have been imposed during the past few years. This change will put the department in the enviable position of having the lowest scale of electricity charges, not only in this kingdom, but also as compared with the United States. The actual scale now current is as under:—Lighting, 4d. per unit (ordinary rate); factory and works lighting and power, 1d. per unit; inclusive domestic rate (for private houses only), for light, heating, cooking or domestic power, a charge at the rate of 10 per cent. per annum upon the net assessment for rateable value, payable quarterly in advance, plus ½d. per unit consumed, no rental being charged for meters; shop window lighting, 2d. per unit; heating, 1d. per unit (ordinary rate). There are also special alternative rates for large factories using electric motors for driving heavy machinery, cranes, &c. An official of the department has given a calculation of the annual cost of electricity to the occupant of an average house rated at £40 per year, assuming an annual consumption of 400 units for lighting and 4000 for domestic purposes. He states that the cost would be £13 3s. 4d. in Sheffield, £17 3s. 4d. in Manchester, and £20 14s. 8d. in Newcastle, while the comparative figures for American undertakings are:—Cleveland Company, £38 13s. 4d.; Detroit Edison Company, £40 5s. 4d.; Pacific Gas and Electric Company, £38 10s. The official adds that the only other town which can come down to anything like Sheffield's level is Southport. He states that in Sheffield electricity is used more extensively than in any other town in the United Kingdom, and that its cheapness is chiefly due to its extensive use in the domestic dwellings of the working classes.

At Halifax and Doncaster.

Halifax Town Council has decided to install a 6500-kW alternator and condenser, with water-tube boilers and complete equipment, at a cost of £159,028. Doncaster Corporation has received the sanction of the Electricity Commissioners to the borrowing of £51,370 for various electricity works and extensions. Doncaster last week brought into use a refuse disposal and salvage plant, constructed at a cost of £19,850. The plant replaces similar works which have been in existence since 1913, and its features include a magnetic separator, clinker plant, and a tin crusher for baling scrap. The same Corporation has accepted the tender of Edcaster, Ltd., of Doncaster, for improving the surface water drainage of parts of the Town Field Estate for £4025.

Sheffield Schemes.

Sheffield Corporation has now begun the work of erecting a new market on the Castle Hill site. The total cost will be approximately £45,000. The contract of the Direct Labour Department, which is carrying out the work, amounts to £36,268. The Ministry of Health has sanctioned the borrowing of £35,521 for the erection of houses on the Longley Estate, and £34,627 for a similar purpose on the Ridgway-road Estate. The following tenders have been accepted:—H. Freckingham and Sons, thirty-seven houses, £13,770; M. J. Gleeson, Ltd., fifty-seven houses, £18,952 10s. A new road widening, which is to be carried out as early as possible, is that of Norton Lees-lane, which connects the city with a rapidly developing district. It is to be made 50ft. wide, at an estimated cost of £6000.

Hull as an Air Port.

Hull Chamber of Commerce is anxious to see the city made into an air port for continental traffic, and has appointed a committee to go into the financial aspect and the question of raising money. It is estimated that the aeroplanes will cost £24,000. The L.N.E.R. Company has been communicated with on the matter and at last week's meeting of the Chamber a letter was read from Sir Ralph Wedgwood, stating that the question was one to which the company had given consideration, but no definite action had been taken. "The provision of an air service both in this country and in Germany," he wrote, "is still a long way from being on a commercial footing, and I understand that heavy subsidies are required. Moreover, the feeling of the Imperial Airways Company at present is that in Great Britain our distances are too short to make an air service ultimately remunerative. In any event I am afraid the L.N.E.R. Company has got many obligations which take priority over the establishment of an air service where it is a question of capital expenditure. If it is a question of co-operation with the air service we shall be very ready to give all the help we can. You may take it that our view is that if air services can be established on a commercial footing they are much more likely to act as complementary to the railway service than as competitors."

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

ALTHOUGH the volume of actual business passing has not materially increased in the past few days, operations are expected to be on a rather considerable scale in the near future. Consumers are less disinclined to pay prices asked, and are disposed to discuss terms for forward delivery, but few contracts have yet been arranged for supply well ahead. An upward tendency in quotations is noticeable, and complaint is still heard that manufacturers are compelled to run plant at a very narrow margin of profit. A continued steady rise in prices of foreign material, owing to overseas firms being heavily sold, has removed continental competition to a large extent, and encourages hope of a good deal of trade being diverted to this district. Should much of the inquiry for iron now circulating materialise in business it would probably be found necessary to increase the number of furnaces in blast, as stocks are low and are being daily reduced. Quotations are firm, No. 1 Cleveland foundry iron being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

Further home and export sales of East Coast hematite pig iron are reported, and values, though still well below cost of output, are markedly firmer. The statistical position of the branch has been greatly strengthened by continued withdrawals from stocks, which are no longer inconveniently large. Producers state they have now just sufficient iron stored for the transaction of ordinary business, and they are taking a decidedly firmer stand than for quite a long time. Until very recently the quotation for mixed Nos. 1, 2 and 3 governed values of different qualities of iron, but mixed numbers are no longer inquired after, consumers confining their purchases to iron of specific analysis, and terms on which contracts are made are a matter of individual bargaining. Orders

cannot now be placed at below 69s., and much more has been realised for iron of superior quality.

Ironmaking Materials.

The foreign ore trade is without new features. Consumers are as disinclined as ever to negotiate for supplies, and sellers appear determined not to depart from the firm attitude they have taken up for some time past. Nominally, market rates remain on the basis of best Rubio at 22s. 6d. c.i.f. Tees. Users of blast-furnace coke are not disposed to make extensive purchases. Good medium qualities keep at 17s. 6d., delivered to works in this area.

Manufactured Iron and Steel.

A little more activity is reported in the manufactured iron and steel trade. Some continental steel producers are understood to be unable to accept further orders except for considerable extended delivery, and this is affording manufacturers here opportunity to make prompt sales. Home business with constructional engineers is improving, and specifications for shipbuilding requisites are being distributed less sparingly. The price of common bars are unaltered, but those of superior qualities have advanced 5s. per ton all round, best bars now being £10 15s., double best bars £11 5s., and treble best bars £11 15s.

The Coal Trade.

In the Northern coal trade situation the outlook is improving, and steady business is in prospect. Northumberland steams for prompt are fairly well booked and stemmed, and quote steadily, whilst forward the tone is improving in the hopes of substantial portions of several large continental contracts now under consideration will be secured to this area. Offers gave been sent in for the Finnish and Swedish Railways' contracts, aggregating about 105,000 tons. The competition from home and foreign districts will be keen, but it is hoped that Northumberland and Durham will participate in the business. The price of best Northumberland steams is firmly held at 13s. 6d. There is not much movement for secondary steams, and prices are quoted unchanged at 12s. and 8s. 3d., for large and smalls respectively. Durham steam coal collieries are fairly well situated with prompt trade, but forward the position is not so bright. Best classes are irregular at 15s. to 15s. 6d. for large and 11s. to 11s. 3d. for smalls. Tyne primes are moving slowly at easy unchanged prices, 12s. 9d. and 9s. 6d. respectively. The gas coal trade meets with a slow demand. The prompt position is disappointing, as under recent active inquiry fitters looked forward to a marked increase in trade. Buyers, however, appear to be marking time, and definite business is only booked in limited volume. The outlook at the moment is uncertain regarding gas coals, but the near approach of the autumn encourages hopes of an early increased demand. The price of best qualities is steady at about 14s. 9d., while secondary kinds are plentiful and freely offered at 13s. to 13s. 6d. for all positions. There is a steadier trade for all descriptions of coke. Makers have been sold for some considerable time past, but found buyers unable to take deliveries through tonnage scarcity. This difficulty is slowly disappearing, and shipments are expanding, with the result that coke prices are hardening. Forward bookings are stated to be substantial, and prices rule firm, gas coke at 19s. 6d. to 20s. 6d.; patent oven cokes, 18s. to 18s. 6d.; beehive and special grade cokes, 23s. to 28s.

Coal Exports.

Although the pits which are working in Northumberland and Durham do not get in full weeks of employment, the shipments of coal from the Tyne compare favourably with the figures of last year. To the end of August coal shipments were down less than 1 per cent., as compared with last year, but coke is up 60 per cent. There has been a strong demand for coke for months past. The average weekly shipments this year have been over 300,000 tons. Much more trade might have been done but for the Yorkshire marketing scheme, which reduces the price of export coal through the medium of a levy on the collieries as a whole. Of 9,134,135 tons of coal and coke shipped from the Tyne in the first seven months of this year, 7,195,373 tons went to foreign destinations. In the same period of 1913 the figures were 8,948,590 tons, which shows the extent to which foreign trade is being recovered. Italy is the steadiest customer. This year that country has taken 1,328,243 tons, whereas in 1913 the total was 1,398,871 tons. There is a heavy falling off to Germany. In 1913 the total for the seven months was 1,556,769 tons; this year it has fallen to 938,107 tons. Belgium and Holland show good increases. In 1913 the former country took 340,103 tons, and this year 676,435 tons; and Holland in 1913 received 328,278 tons, and in the past seven months 577,471 tons. The Thames is not taking so much as it did in 1913, when the figures were 2,230,278 tons, as compared with 1,666,919 tons this year.

SCOTLAND.

(From our own Correspondent.)

New Rubber Works at Inchinnan.

LAST week-end the new rubber works owned by the India Tyre and Rubber Company (Great Britain), Ltd., were formally opened by Lieutenant-Colonel A. D. M. Innes-Shaw. The factory at Inchinnan occupies part of the aerodrome built by the Government during the war. The site extends to over 65 acres, giving ample room for extensions to existing buildings and the erection of houses for employees should the necessity arise. At present 200 workers are employed and the daily output of the plant in operation is rated at 200 tires, and when the requisite alterations are completed the output will be increased to 2000 daily. The foundations of the new works were laid in January last and the production of tires was actually in progress at the end of June last.

Steel.

In view of a somewhat better inquiry and the continued upward trend of continental prices steel makers are becoming more hopeful. Steel makers are steadily engaged, but the full capacity of the works is not in any way taxed. Sheet makers are doing a good business, especially in the lighter gauges. Tube makers are comparatively well placed, their chief complaint being the low price obtainable for export.

Iron.

The bar iron trade is still depressed and makers are depending to a great extent upon the orders for re-rolled steel. Continental billets have risen to £5 or £5 10s. per ton and are not now much cheaper than local products. Re-rolled steel bars are quoted at £7 10s. minimum for home delivery and £7 7s. 6d. to £7 10s. per ton f.o.b. Glasgow. While only some twenty-two furnaces are in blast, the production of pig iron is more than sufficient to meet all requirements.

Exports and Imports.

During the past week imports at Glasgow included 4500 tons iron ore, 2700 tons pyrites, and 1900 tons of steel and iron products. Exports included 4000 tons of steel and iron and 493 tons of pig iron.

Coal.

The Scottish coal market continues without any important change. Export demands are still at a minimum, orders being chiefly for small lots for the completion of contracts. Home demands are only moderate and round fuels are as a rule easily obtained. Washed nuts maintain their position owing to a scarcity of supplies. First-class Fifeshire steams find a steadier outlet owing to more frequent arrivals of steamers at the loading ports. Aggregate shipments for the past week amounted to 263,942 tons, against 233,855 in the preceding week and 254,805 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

IT must be admitted that the returns of shipments from this district last week were disappointing, as the total is given as just over 360,000 tons, as against 428,480 tons the previous week. It was thought that with a more regular supply of tonnage there would have been a better result. The week terminated with a total of twenty-six idle tipping appliances at the various ports, which figure is lower than has been the case many times this year. The possibility, however, is that when the complete returns are available it will be found that shipments have been on the whole better than is indicated by this preliminary total of shipments. The figures for the whole of August have proved far more satisfactory than was looked for, as the total is now given as 1,831,827 tons, which, despite the fact that holidays interfered with operations, was about 170,000 tons higher than the quantity for the preceding month and about 120,000 tons better than the returns for the corresponding period of last year. There is some hope that the figures for September will prove equally as satisfactory, as chartering of late has been distinctly more active and there is still a good inquiry for prompt steamers. This week started with the docks showing a total of twenty-four idle tipping appliances, but there are indications that the second half of this month will display more activity in loading, as there is a good amount of tonnage due to come along during the next week or so. Unfortunately, all collieries are not feeling the benefit of this improvement. The collieries which are busy and are very fully stemmed for the next fortnight are those which produce the best qualities. There are numerous pits producing the lower grades which are still hard up for orders. It is, however, satisfactory to record that the inquiry for single cargoes is slightly better, though so far as contract operations are concerned the only new business on the market at the moment is for 27,000 tons of superior Admiralty large coals for account of the French marine. These coals are for delivery at Cherbourg, Brest and other French naval bases during the last quarter of this year.

Other Coal Items.

The rumour is current that for the future the allocation for British coals at Barcelona is to be reduced from 52 per cent. of the total consumption to 40 per cent. More information is being sought, as to whether this reduction in percentage is meant to apply, not only to the Barcelona district, but to other areas. As is well known, the Spanish authorities have for a long time past introduced restrictive measures with a view to helping the native industry, though the steps so far taken by them have not prevented some of the Asturian mines closing down. Ever since the stoppage in the coal industry two years ago the pits belonging to Locket's Merthyr at Mardy have been closed, but a resumption is now gradually being made, and on Saturday last the first train of coal was sent out. Over 2000 men were formerly employed at these collieries. There is to be an extraordinary meeting of shareholders in the Amalgamated Anthracite Collieries, Ltd., on the 17th inst., when they will be asked to sanction the increase in capital of the company by £2,500,000 to enable the share capital of Welsh Anthracite Collieries, Ltd., and Henderson's Welsh Anthractie Collieries, Ltd., to be acquired. In a circular sent out to shareholders and signed by Lord Melchett it states that the completion of these two acquisitions will result in placing under single control and direction approximately 80 per cent. of the total output of Welsh anthracite, and is the logical sequence to the efforts the company has consistently made to unify and stabilise the anthracite section of the coal industry. It will afford the necessary facilities for controlling production and the development of further mineral areas with greater regard for economical working. It will also make for the avoidance of those wide and purposeless variations in prices resulting from that cut-throat inter-colliery competition to which the coal industry has been subject in recent years with such disastrous results. Indeed, since the offers to acquire were made the preliminary steps which have been taken to suspend unnecessary price cutting are already bearing fruit. The arrangement will also give scope for more efficient distribution at reasonable prices to the consumer, leading to an expansion of demand.

Steel and Tin-plates.

Owing to trade depression the steel works and engineering shops of Guest, Keen and Nettlefolds, Ltd., at Dowlais were temporarily closed down on Friday of last week and about 2000 men are therefore out of employment. Work, however, is being continued at the blast-furnace department, the coke ovens and the by-product plant, where some 1500 men are engaged. The report has been current that several mills and furnaces are to be re-started at the Port Talbot Steel Works, but unfortunately this is not correct. One mill which has been idle for two and a-half years is to be re-started in about a fortnight's time, and this will give employment to about eighty men. The report has been current this week that an agreement has been definitely made between American and Welsh producers of tin-plates for a geographical distribution of the oversea trade, thus eliminating competition and resulting in South Wales having about 70 per cent. and the United States 30 per cent. of the world's export markets. Official information, however, is so far not forthcoming that such is the case, though negotiations are believed to be very near completion.

Current Business.

The tone of the steam coal market has been rather steadier during the past week. This applies more especially to the superior grades, which in a number of instances are very fully booked for the next week or two. Inferior descriptions are not so well off for orders by any means, but small coals maintain a very good tone. The bunkering business has received a fillip by reason of the requirements of a number of whalers paying their seasonal visit to this district prior to going whaling. It is estimated that altogether they will be taking about 100,000 to 150,000 tons of coal. Sized coals are also very steady, but patent fuel is extremely quiet. Pitwood is on the firm side at 29s. to 29s. 6d.

EDUCATIONAL INTELLIGENCE.

THE SIR JOHN CASS TECHNICAL INSTITUTE, JEWRY-STREET, ALDGATE, E.C. 3.—In the Department of Metallurgy of this Institute the two following courses of lectures will be given in the forthcoming session:—"Foundry Practice," by L. Singlehurst Ward, B.Sc., and A. F. Gibbs, on Monday evenings, 7–10 p.m., commencing September 24th. The course will consist of lectures and demonstrations accompanied by practical work in moulding, core-making and casting. "Foundry Metallurgy," by Geo. Patchin, A.R.S.M., on Friday evenings, 7–9 p.m., commencing September 21st. This course will consist of lectures and class work and may be taken concurrently with the above course in foundry practice. The Principal, Mr. Geo. Patchin, will be pleased to supply particulars of these and other courses given in this department.

CHELSEA POLYTECHNIC, MANRESA-ROAD, CHELSEA, S.W. 3.—In the Department of Chemistry and Metallurgy of this Polytechnic day courses in general metallurgy and assaying, a short course on assaying, mineralogy and surveying, and a short course on the principles of assaying will open on September 24th. Further particulars can be obtained from the Secretary of the Polytechnic.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. DAVID HAMILTON having joined the board of the British and Foreign Machinery Company, Ltd., has transferred to that company the agencies formerly held by David Hamilton and Co., and this business is being carried on by the first-named company.

LEWENZ AND WILKINSON, Ltd., engineers, 25, Victoria-street, S.W. 1, advise us that Mr. E. R. Wynne has resigned his seat on the board of the company and that Mr. Cyril W. Davson, A.M.I. Mech. E., A.M. Inst. P.T., joined the board of the company in February last.

THE INTERNATIONAL COMBUSTION ENGINEERING CORPORATION, of America, which is associated with International Combustion, Ltd., of this country, has concluded negotiations for the acquisition of the entire business and assets of the Hedges-Walsh-Weidner Company, of Tennessee, which is a recent combination of the Casey Hedges Company and the Walsh and Weidner Boiler Company. As a result of the new acquisition the International Combustion Engineering Corporation will add to its present extensive manufacturing organisation two of the biggest boiler plants in the world.

CATALOGUES.

ROBERT CRAIG AND SONS (ENGINEERS), Ltd., York-street Engineering Works, Belfast.—Copy of the firm's water turbine catalogue.

BUDENBERG GAUGE COMPANY, Ltd., Broadheath, Manchester.—Catalogue Section 54 dealing with instruments for liquid depth measurements.

MCGRAW-HILL PUBLISHING COMPANY, Ltd., 6 and 8, Bouverie-street, E.C. 4.—List No. 3. McGraw Hill books on Chemistry and Chemical Engineering.

STEVENS AND STANSFELD, Sentinel House, Southampton-row, W.C. 1.—Folder on the "Traberg" electric boiler scaling and rust-removing apparatus.

J. H. TUCKER AND CO., Ltd., King's-road, Tyseley, Birmingham.—Folder Ref. S7. A page of new prices for Tucker iron boxes, with and without switches.

TUNGSTONE ACCUMULATOR COMPANY, Ltd., 3, St. Bride's House, Salisbury-square, E.C. 4.—A detailed price list of Tungstone accumulators for all purposes.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	18/6 to 21/6
(1) Spanish	18/6 to 21/6
(1) N. African	18/6 to 21/6
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 9 0	3 9 0
No. 1	3 10 0	3 10 0
Cleveland—		
No. 1	3 8 6	3 8 6
Siliceous Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Matlied	3 4 0	3 4 0
White	3 4 0	3 4 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 6 to 2 17 6	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	2 19 0 to 3 0 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	2 19 0	—
No. 4 Forge	2 17 6	—
Basic	2 19 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 4 6 (b) / 4 8 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G.)	13 10 0	13 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 15 0 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 2 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	209 12 6
,, (three months)	208 5 0
Copper (cash)	62 15 0
,, (three months)	63 5 0
Spanish Lead (cash)	22 5 0
,, (three months)	22 0 0
Spelter (cash)	24 15 0
,, (three months)	24 16 3
MANCHESTER—	
Copper, Best Selected Ingots	66 15 0
,, Electrolytic	69 10 0
,, Strong Sheets	94 0 0
,, Tubes (Basis Price), lb.	0 1 1¼
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	23 15 0
,, Foreign	22 7 6
Spelter	25 0 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£20 10 0	7/–
,, ,, 8 p.c. to 10 p.c. ,,	£20 0 0	6/–
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/–
,, ,, ,, 1 p.c. carbon	£37 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£41 0 0	17/–
,, ,, ,, carbon free	1/– per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0	0 scale 5/– per unit
,, ,, 75 p.c.	£19 0 0	0 scale 6/– per unit
,, Vanadium	14/– per lb.	
,, Molybdenum	4/– per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£175	
Ferro-Cobalt	9/– per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/3 to 14/6
,, ,, Splint	16/– to 16/9
,, ,, Trebles	13/3
,, ,, Doubles	13/–
,, ,, Singles	12/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	13/6 to 13/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/– to 12/6
Screened Navigation	13/–
Trebles	14/– to 14/6
Doubles	13/6 to 13/9
Singles	12/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/3
Secondary Steam	11/9
Trebles	13/6
Doubles	13/3
Singles	12/6

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/–
Household	37/6 to 50/–
Coke	22/6 to 23/6
NORTHUMBERLAND—	
Best Steams	13/3 to 13/6
Second Steams	11/9 to 12/–
Steam Smalls	9/– to 9/6
Unscreened	11/9 to 12/–
Household	21/– to 27/–
DURHAM—	
Best Gas	15/–
Second	13/3 to 13/9
Household	21/– to 27/–
Foundry Coke	18/3 to 19/–

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/– to 27/6	—
Derbyshire Best Bright House	21/– to 22/6	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	16/– to 17/–	—
,, ,, Nuts	14/– to 16/–	—
Yorkshire Hards	14/6 to 16/–	—
Derbyshire Hards	14/6 to 16/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/–	—
Smalls	3/– to 4/6	—
Blast-furnace Coke (Inland)	13/– at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/– to 19/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/– to 19/–
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/– to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/– to 17/3
Best Eastern Valley Large	16/6 to 17/–
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/–
Ordinary Smalls	10/6 to 12/–
Washed Nuts	16/6 to 19/–
No. 3 Rhondda Large	19/6 to 20/–
,, ,, Smalls	14/– to 14/6
No. 2 ,, Large	16/– to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	27/– to 36/–
Furnace Coke (export)	19/– to 21/–
Patent Fuel	20/6 to 21/6
Pitwood (ex ship)	29/6 to 30/3
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	34/– to 35/6
Seconds	24/6 to 27/6
Red Vein	20/6 to 27/–
Machine-made Cobbles	40/– to 43/6
Nuts	35/– to 43/6
Beans	23/6 to 26/–
Peas	18/– to 19/–
Breaker Duff	8/– to 8/3
Rubbly Culm	11/6 to 11/9
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	10/– to 12/6
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Trade.

RATHER more interest is likely to be taken in the meetings to be held in the coming week, particularly that of the Steel Union in Luxemburg, when it is expected that Germany will again raise the question of penalties for over-production which appeared to have been settled at the last meeting. Since then the situation has certainly undergone a change in the direction of a better foreign demand and hardening prices. In Germany there has been an increase in the exports of steel, and producers have exceeded their quota, as is probably the case also in some other countries, and in view of the possibility of Germany being required to pay a penalty on the higher scale for a larger percentage of increase over and above the amount allotted there is already some complaint of the penalty being unjustified on the ground that production costs have been augmented by higher wages and railway freights. In other words, the Germans affirm that they are already penalised by these increased charges, which place them in a less favourable position for selling steel abroad than the French and Belgians. It is suggested that the only way out of the difficulty is to create a Sales' Office for the foreign trade, and there is no doubt that the German steel producers are working to that end. It is not expected that any change will be made at the forthcoming meeting in the production of steel for the last quarter of the year.

Air Service.

The series of failures which seem to indicate that there is something wrong in the organisation of the air service have so strongly impressed public opinion that the Government has at last been compelled to decide upon the creation of an Air Ministry, which will centralise all branches of the service and carry out a policy of rational development, both technical and commercial. This reform has followed immediately on the death of M. Bokanowski, Minister of Commerce and Aviation, who perished with the pilot and three others in the accident at Toul, when the machine in which he was flying lost speed at a low elevation, and, crashing to the ground, burst into flames. It is recognised that the present system of decentralisation which separates completely the services under the control of the War Department, the Navy and the Colonies has been productive of a waste of effort. The Minister of Aviation, who was at the same time Minister of Commerce, supplied the different services with machines, and had under his control the direction of civil flight, but he had nothing to do with the naval and military services, which were absolutely distinct. The Government has repeatedly attempted to centralise all the services in an Air Ministry, but has failed to overcome the military and naval opposition, which holds tenaciously to separate control. The catastrophe at Toul brought matters to a head, and the reform is to be accomplished without further delay. It appears likely that the new organisation will be based upon the British system, though modified to suit the special requirements of this country. The immediate effect will be the carrying out of an extensive organisation which will include the opening up of air services with the Colonies, particularly with Indo-China.

Railway Material.

The railway companies have been so far limiting their requirements in rolling stock and other material that wagon builders and manufacturers of accessories have passed through a long period of inactivity, and they have probably suffered more than other firms from the placing of orders in Germany on account of reparations. Nevertheless, as the Government has undertaken to distribute amongst French manufacturers orders equal in value to that of the work given to German makers, the increased importance of the reparation work is now benefiting the home firms. Following upon the recent catastrophe at Le Mans, the Government will order shortly 200 all-metal postal vans, to be supplied equally by French and German builders, and at the same time 116 metal coaches will be constructed for the local lines. Of particular interest to makers of accessories is the recent placing of a contract with the Kunze-Knorr Company, of Berlin, for the supply of one-half of the Westinghouse brakes with which the goods trains are to be equipped. Arrangements are already being made for the distribution of orders for the other half amongst French makers. The total value of the brakes and accessories to be supplied is 350 million francs, and this will provide a large number of firms with employment for the next four or five years.

Outlawry of Tariffs.

One of the leading associations in France for the development of trade has appealed to the French Prime Minister to follow up the Pact for the outlawry of war by a similar international undertaking to abstain from all economic hostilities. It is perfectly clear that if wars, arising more or less out of economic causes, were eliminated there would be little reason for international friction, and in the opinion of the Association a declaration in favour of the abolition of economic wars would be more effective than the new Pact. Unfortunately, while all countries declare officially at Geneva and elsewhere that they approve of the suppression of barriers to trade, there is not one which does not find itself committed to a more thorough system of protection than ever before. If the outlawry of economic war is to be declared, foreign countries must give up all idea of artificially stimulating industries by protective duties and export bounties, and must return to the principle of buying in the cheapest markets, which means that each country will produce goods for the manufacture of which it has special facilities, and when all countries see that they are dependent on each other for their prosperity, there will be less inducement on the part of any of them to cause trouble. While that principle is admitted, there is, unfortunately, a tendency amongst continental countries to hold rigorously aloof from it.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

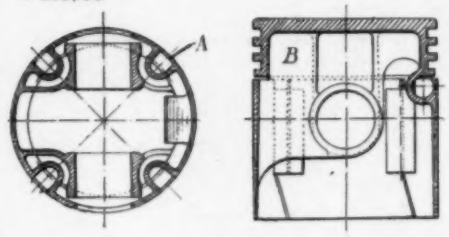
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

295,153. November 11th, 1927.—PISTONS, A. Aumeteyer and F. Piazzoli, 21, Boulevard Lefebvre, Paris.

The skirt of this piston is made elastic by being divided into segments connected together by U-shaped channels, as shown

N°295,153



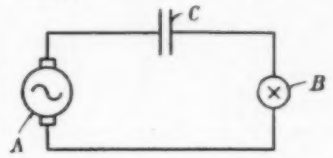
at A. One of these segments, the head and the gudgeon pin bosses are rigidly connected together by webs B.—*August 9th*, 1928.

DYNAMOS AND MOTORS.

295,097. June 9th, 1927.—IMPROVEMENTS RELATING TO ELECTRIC LIGHTING SYSTEMS AND APPARATUS, The M.L Magneto Syndicate, Ltd., and Ernest Ansley Watson, both of Victoria Works, West Orchard, Coventry.

This invention relates to electric lighting systems and apparatus and particularly to fluid operated apparatus for use in mines. It has for its object the provision of an improved automatic control between the lamp and the generator, so as only to permit the requisite current to pass to the lamp when the speed of the generator reaches a predetermined amount. In the diagram A represents the alternating current generator, B the lamp and C a condenser. The capacity of the condenser is so proportioned that when the generator A is operating at its normal speed the current which is passed by the condenser is sufficient to permit of the lamp being operated at its normal brilliancy. In the event of the generator speed being reduced, the current flowing through the condenser is reduced, not only by the reduction in electromotive force, but also by the

N°295,097



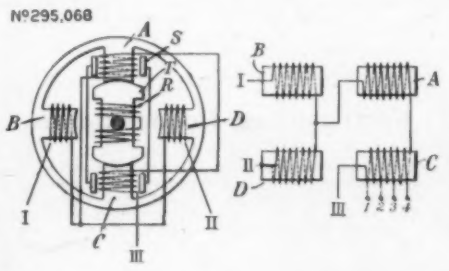
reduction of frequency. The current flowing, and therefore the load on the generator, falls off much more rapidly than the speed. These conditions tend to increase the stability of the circuit, and are of particular benefit in the case of a generator driven by a compressed air turbine. As most small turbines of this type operate at blade speeds much below the nozzle velocity of the propelling fluid, the torque exerted by the turbine is practically constant over a wide range of speed. Further, with a metal filament bulb the temperature coefficient of the filament tends to maintain the load at lower speeds, owing to the decreased resistance of the filaments, as the current drawn from the generator, and hence the torque reaction on the turbine does not fall linearly with the speed, as it would if the resistance were constant. Such a combination, in the absence of the condenser described will, therefore, tend to be unstable if used over a varying range of air pressure. With the condenser in circuit, however, the current and torque on the turbine will fall much more rapidly as the speed is reduced and comparative stability will, therefore, be obtained.—*August 9th*, 1928.

TRANSFORMERS AND CONVERTERS.

295,068. May 11th, 1927.—IMPROVEMENTS RELATING TO ALTERNATING ELECTRIC CURRENT PHASE CONVERTERS, Edmund Schröder, of No. 48/51, Maybach-Ufer, Berlin, S.O. 36, Germany.

This invention is applicable more particularly to resistance heating and welding machines. By means of the well-known Scott connection and also a transformer action, three-phase

N°295,068



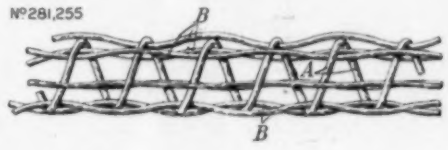
alternating-current is converted into single-phase current. The stator comprises four pole pieces A, B, C, D situated at right angles to each other. These are excited from a three-phase system by windings arranged in accordance with the well-known Scott connections. The three phases are indicated by I., II., III., and the mode of connecting the windings is illustrated more clearly by the left-hand diagram. The pole A is also surrounded by a single-turn winding S, forming the secondary of a transformer. If desired a similar secondary winding may be arranged in combination with the pole C, as shown, the two windings being connected together in parallel. This is a two-pole rotor, which may be in the form of a shuttle armature. The rotor is excited by a direct-current winding R. The system will operate as a synchronous motor, and to facilitate starting squirrel-cage bars may be combined with the rotor. A single-phase current is generated in the winding S, and this action is supplemented by means of the rotor. Under the influence of the poles B, D, rotational energy is imparted to the rotor, and when the rotor moves in the neighbourhood of the poles A, C, current is generated in the winding S, in phase with that produced by the transformer action. The current produced in the winding S is therefore derived partly from a transformer action, and partly from the rotational energy imparted to the rotor. To enable the output of the machine to be varied, the winding surrounding the pole C is provided with tappings 1, 2, 3, 4, at any one of which connection can be made with the supply system.—*August 9th*, 1928.

TRANSMISSION OF POWER.

281,255. November 8th, 1927.—ELECTRIC CABLE, Société Electro-Câble, of 2, rue de Penthièvre, Paris.

This specification describes a cable comprising a hollow core and longitudinal wires around the core. It has been proposed to construct cables of this type comprising wires resting in notches of the core, which consists of a helix of paper or other insulating material. The cable, which forms the subject of the invention, comprises a core which consists of a wire or strip A wound in a coil after the manner of a spring. The core serves as a support for a layer of conducting wires B, which are inter-

N°281,255

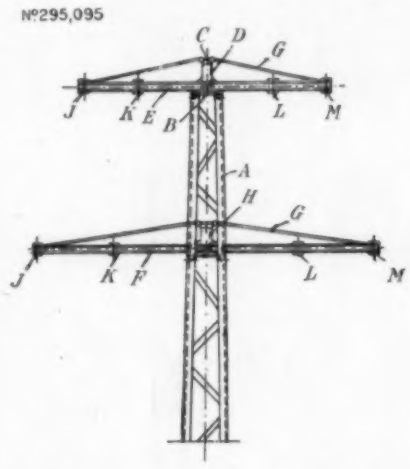


woven with the core, which serves as the woof, and the wires are placed longitudinally in the direction of the cable and constitute the warp. The conducting part of the cable is disposed at the periphery, the central part being left empty or filled with a suitable substance. With an equal cross-section for conducting the current, a marked diminution of the corona effect and skin effect is said to be obtained, whilst the spring-like core is well consolidated and the resistance of the resulting cable against any deformation is increased, but without any increase in its rigidity.—*August 9th*, 1928.

295,095. June 7th, 1927.—IMPROVEMENTS RELATING TO MASTS USED IN THE TRANSMISSION OF HIGH-TENSION ELECTRIC CURRENTS, Fritz Berg, of 13, Kepplerstrasse, Mannheim, Germany.

The mast A has a horizontal bearer plate B, on which a carrier pintle C is fixed. On this pintle there is a cylindrical bearing boss D to the base of which a rigid carrier arm E is fixed, the outer ends of which are stayed by tension bars G engaging in the upper end of the cylindrical boss D. At any suitable point of the mast there is a second carrier arm F with tension rods which engage with a cylindrical body H. The carrier arms each support two conductors for the high-tension current, these conductors being fixed at the points J, K, L and M by means of the usual

N°295,095



insulators. The carrier arms E and F can swing through an adequate angle in a horizontal plane to effect the necessary tension of the wires so as to balance out the torsional forces on the arms. If an excessive force falls on one side of the carrier arm the torsional forces are not taken up by the stresses set up in special tensioning devices, but are balanced out and nullified by a slight rotary movement of the mast arm. In this way the mast arms are free of excessive bending moments, and are only loaded by relatively small shearing forces. If, for instance, one conductor M breaks, the stresses set up are compensated by the conductors J, K, L, and the carrier arm is prevented from swinging too far or imparting any other kind of undesirable action to the supporting mast A. The mast is thus freed in such a case from the harmful action of overloads.—*August 9th*, 1928.

MISCELLANEOUS.

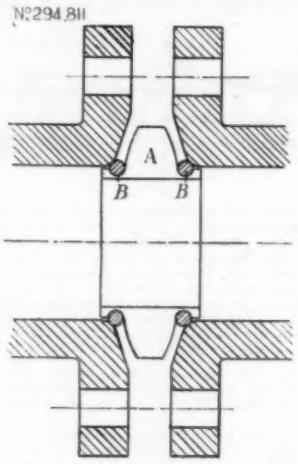
295,194. February 17th, 1928.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CURRENT RECTIFICATION, Laurence St. Clair Broughall, of Woodview, Hadley, Hertford.

It is well known that when a layer of cuprous oxide is formed on a surface of metallic copper the resistance to electric current flowing from the oxide to the metal is less than the resistance to electric current flowing from the metal to the oxide. This principle has been made use of in connection with electric current rectification, and rectifying elements consisting of a layer of cuprous oxide on a copper blank have been produced by heating the copper blank in an atmosphere of air or oxygen to a temperature approximating to 1050 deg. Cent. This process, however, is open to the objection that, since at lower temperatures the copper combines with oxygen to form cupric oxide, a considerable amount of cupric oxide will always be produced together with the cuprous oxide. The cupric oxide has no rectifying properties and must therefore be subsequently removed. According to this invention the copper blank is heated in an atmosphere of nitrous oxide. At the lower temperature

the nitrous oxide combines with the copper to form cuprous oxide in an amorphous state. As the temperature is increased, the nitrous oxide decomposes homogeneously with the formation of nitrogen and oxygen; but at this point the temperature is so high that the oxygen combines with the copper to form cuprous oxide in preference to cupric oxide. Further increase of the temperature is desirable and results in the formation of cuprous oxide in the crystalline state, and a new reaction now occurs, namely, the heterogeneous formation of nitric oxide, by the cuprous oxide, which acts as a catalyst for the decomposition of the nitrous oxide. When a suitable layer of crystalline cuprous oxide has been formed, the blank is allowed to cool, at first gradually, and then more rapidly, if necessary by immersion in water or oil. The temperature at which rapid cooling commences may suitably be when the blank is at a very dull red heat. If the temperature at which rapid cooling is allowed to take place be too high then the cuprous oxide is liable to crack off owing to the difference in the coefficients of expansion of cuprous oxide and copper; if, however, it be too low the crystallisation may have proceeded too far, and the crystals be too large for effective rectification. Any small particles of cupric oxide, which may have formed on the surface may then be removed, either mechanically or by chemical means, and the blank is now ready for use in a rectifying unit.—*August 9th*, 1928.

294,811. November 3rd, 1927.—HIGH-PRESSURE PIPE JOINTS, Imperial Chemical Industries, Ltd., Broadway Buildings, Westminster, S.W. 1, and P. G. Corin, Norton Hall, The Green, Norton-on-Tees, Durham.

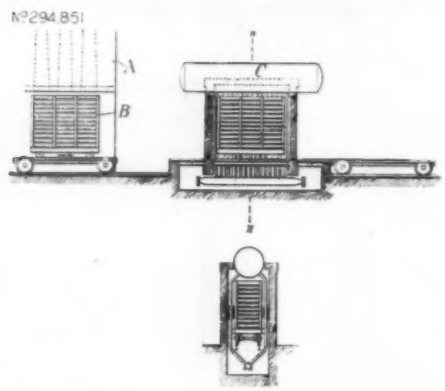
In the illustration this joint is shown as it is before being tightened up. The actual joint is made between the lens-shaped



ring A and the faces of the flanges on the ends of the pipes, which are so formed that they make line contact. The packing rings B B, of rubber, or other soft material, are introduced to prevent the access of gritty material to the joint, but they have to support no pressure difference.—*August 2nd*, 1928.

294,851. January 31st, 1928.—DRY COOLING OF COKE, *B. E. D. Kilburn*, 31, *High Holborn, London, W.C.* 1.

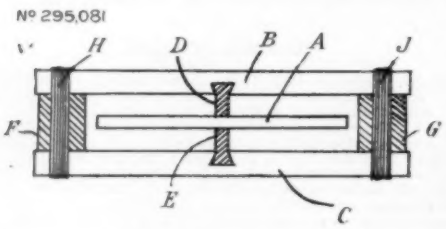
According to this scheme the incandescent coke is discharged from the ovens A into a truck B, and this truck is wheeled into the water-tube boiler C. There it is completely enclosed by



doors and remains until the coke has given up its sensible heat to the water. The water tubes, it will be seen, are so placed that there is room for the circulation of the gases within the boiler casing.—*August 2nd*, 1928.

295,081. May 21st, 1927.—IMPROVEMENTS RELATING TO THE MOUNTING OF PIEZO-ELECTRIC CRYSTALS, Herbert James Lucas, of "Banavie," 201, Burnt Ash Hill, Lee, London, S.E. 12.

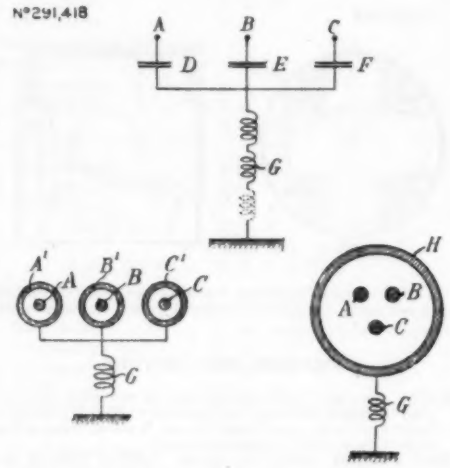
Experience shows that quartz resonators used as frequency standards are not to be relied upon to the degree of accuracy usually accredited to them. It has been pointed out that irregu-



larities occur owing to the mode of support and the cleanness and dryness of the surface of a quartz crystal, and that the irregularity probably depends upon the electrostatic losses on the surface of the crystal, as mentioned by D. W. Dye in "Proceedings" of the Physical Society," Volume 38, page 421. It is found that with the usual type of mounting the best results usually obtainable are within 2 parts in 100,000, and that is variable to the extent of 1 part in 2500. By use of the novel mounting, however, a determination to within 2 parts in 1,000,000 may quite easily be obtained, and the variations are within the accuracy of determination. According to the invention, a resonator A is held between the electrodes B, C by clamping members D, E which are dovetailed or otherwise secured to the electrodes. Blocks of fused quartz F, G maintain the electrodes in the correct position, the whole being secured by a wrapping of silk at each end (H, J).—*August 9th*, 1928.

291,418. October 17th, 1927.—CONNECTION FOR FEEDING WATTMETRICAL RELAYS ADAPTED TO PROTECT ELECTRIC MAINS, Union d'Electricité, of 87, rue Pierre Charron, Paris, France.

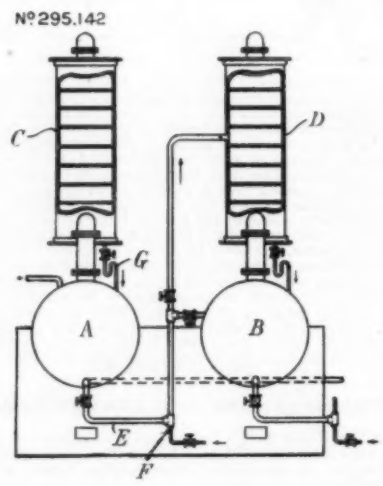
Most of the damage which occurs in high voltage mains is due to the earthing of a phase, which produces a short circuit in systems having an earthed neutral. To protect lines against earth faults it is obviously possible to use only one relay for all phases and to make the asymmetrical components of the currents and voltages act on this relay. In the upper diagram A, B and C are the line wires; D, E and F three similar condensers, each having one plate connected with a line wire, the other plates being all connected with the winding G of a wattmetrical relay which is earthed. Several relays might be inserted in



series. The two lower diagrams show how the condensers can be simply provided in the case of underground lines comprising three distinct conductors or three conductors forming a single cable. In each case the three conductors A, B, C form the first series of condenser plates or armatures. The second series is formed by a portion of the metal armouring A^1, B^1, C^1 in the first case, and by the sheath H in the second. The sheath is insulated from the remainder of the armouring and earthed through the winding G of the wattmetrical relay. The metallic sheathing forming the armouring is severed a few metres from the bus-bars and the part of the sheathing nearest the bus-bar is insulated with respect to earth. This part of the sheathing is connected to the winding of the relay and is earthed through this winding. It thus acts as the second plate of the condenser.—*August 9th*, 1928.

295,142. September 8th, 1927.—DISTILLING HYDROCARBONS, C. Arnold, 11, *Southampton Buildings, London, W.C.* 2.

This invention virtually amounts to the application of the air lift well principle to the transfer of oil from one still to another. Two successive stills are shown at A and B, with their fractionat-



ing towers C and D, from which the condensable vapours escape at the top. The heavier residue leaves by the pipe E, and is raised by the introduction of air or steam at F into the second tower, and so on. Reflux lines G allow for heavy condensate being returned to the stills. It is suggested that the process may be carried out either continuously or batch by batch.—*August 9th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF MARINE ENGINEERS.—In connection with the official visit of the Institute members to the Machine Tool and Engineering Exhibition at Olympia a paper will be read in the Exhibition Lecture Hall entitled "A Note Discussing the Importance of Electricity in the Modern Ship, with Special Reference to the Potentialities for Marine Propulsion," by Mr. A. C. Hardy, B.Sc. 6.30 p.m.

THE CERAMIC SOCIETY: REFRACTORY MATERIALS SECTION.—The Societies' Room in the Royal Technical College, George-street, Glasgow. Papers: "Refractories for Electric Elements," by Mr. P. Cooper; "Notes on Refractories for Salt Glazed Kilns," by Mr. W. Emery; "Drying Cracks," by Mr. C. E. Moore; "The Functions of Regenerators in Relation to the Properties of the Refractories of Construction," by Mr. A. T. Green; "A Comparison of the Properties and Industrial Durability of Lime-bonded and Clay-bonded Silica Bricks," by Mr. W. J. Rees; and "The Dissociation of Carbon Monoxide in Contact with Fire-clays and Silica," by Messrs. W. J. Rees and D. W. Hubbard. At 10.30 a.m. each day.

WEDNESDAY, SEPTEMBER 5TH, TO SATURDAY, SEPTEMBER 22ND.

THE FOURTH MACHINE TOOL AND ENGINEERING EXHIBITION at Olympia.

FRIDAY, SEPTEMBER 14TH, TO SUNDAY, SEPTEMBER 16TH.

THE ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—Fifth annual Conference at New College, Oxford.

SATURDAY, SEPTEMBER 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Junior Section will pay a visit to the works of Leyland Motors, Ltd. Party will leave Manchester Victoria Station at 1.40 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the locomotive works of the Vulcan Foundry, Ltd., Newton-le-Willows. Train leaves Exchange Station, Manchester, at 8.55 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Swanage. South-Western District meeting. 11.30 a.m.

TUESDAY, SEPTEMBER 18TH.

INSTITUTE OF MARINE ENGINEERS.—85, The Minories, Tower Hill, E. 1. Presidential address, delivered by Sir Alan G. Anderson, K.B.E. 6.30 p.m.

FRIDAY, SEPTEMBER 21ST.

SOCIETY OF GLASS TECHNOLOGY.—St. Peter's Hall, Bournemouth. "The Value of the Thermal Expansion Factor of Aluminium Oxide in Glass," by Messrs. I. Kitaigorodsky and S. Rodin; "A Study of the Ultra-violet Light Transmission of Glass," by Mr. D. Starkie and Professor W. E. S. Turner. 2 p.m. Public lecture at 4.30 p.m. on "Modern Art Glass," by Professor W. E. S. Turner. Banquet at the Town Hall. 7 for 7.15 p.m.

MONDAY, SEPTEMBER 24TH, TO SATURDAY, OCTOBER 6TH.

WORLD POWER CONFERENCE.—Fuel Conference. Imperial Institute. For programme see page 719, June 29th.

TUESDAY AND WEDNESDAY, SEPTEMBER 25TH AND 26TH.

IRON AND STEEL INSTITUTE—Autumn meeting in Bilbao, Spain. For programme see page 209, August 24th. 10 a.m. each morning.

FRIDAY AND SATURDAY, SEPTEMBER 28TH AND 29TH.

THE FARADAY SOCIETY.—A general discussion on "Homogeneous Catalysis," to be held in the Physical Chemistry Laboratory of the University of Cambridge.

FRIDAY, OCTOBER 5TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Interesting Details of Swiss Alpine Railways," by Mr. A. J. Simpson. 7.30 p.m.

SATURDAY, OCTOBER 6TH.

ELECTRICAL POWER ENGINEERS' ASSOCIATION: SOUTHERN DIVISION.—Hotel Cecil, Strand, W.C. 2. The tenth annual dinner to the members of the National Executive Council, at 5.30 for 6 p.m. Tickets, 7s. 6d., may be obtained from P. Gordon Hiett, hon. secretary, Southern Division, 25, Parkhurst-road, Bowes Park, N. 22.

WEDNESDAY, OCTOBER 10TH.

THE INSTITUTE OF FUEL.—At the Chemical Society's Rooms, Burlington House, Piccadilly, W. 1. Mr. T. A. Peebles, of Pittsburgh, will read a paper on "Automatic Combustion Control of Liquid, Solid and Gaseous Fuels." 6 p.m.

THE JUNIOR INSTITUTION OF ENGINEERS.—Lieut-Colonel J. T. C. Moore-Brabazon, M.C., has accepted the invitation of the Council to become President of the Institution in succession to Sir Murdoch MacDonald, K.C.M.G., C.B. His induction will take place at a meeting to be held at the Royal Society of Arts, on Friday, December 7th, when he will deliver his address.

LLOYD'S REGISTER SCHOLARSHIP.—The Council of the Institute of Marine Engineers desires to make known as widely as possible amongst apprentice and junior engineers particulars of the Lloyd's Register Scholarships. These are three in number, one being available each year for three years at £100 per year. They are kindly offered by Lloyd's Register of Shipping. Application should be made by intending candidates not later than March 7th, 1929, in order that arrangements may be made for the examination on the dates announced below. The examination will be held simultaneously in the various centres to suit the residences of candidates. The regulations, with lists of subjects on which questions will be set, are as follows:—(1) The Scholarship is open for competition to candidates who are British subjects, *i.e.*, all who are of British parentage in its Imperial sense, the age limit being from eighteen to twenty-three at the date for entering the University. Preference will be given, in the event of nearly equal marks, to the candidate who acquits himself best at the subsequent oral examination before a special committee. The successful candidate, if not already associated, must join the Institute in the grade for which he is qualified. (2) The Scholarship is intended to assist marine engineering students to obtain an advanced course of instruction in engineering subjects. The successful candidate will be required to give an undertaking that he will enter himself as a student and take up the recognised degree course for engineering students at some approved University. (3) The holder of the Scholarship must show satisfactory progress in his course of study at the termination of each session, in addition to which he should satisfy the Committee of Lloyd's Register as to his employment during the recess. (4) Only those are eligible who have served at least two years in a commercial engineering workshop, and until the time of application have been employed in engineering either ashore, afloat or at college, with the intention of entering upon the profession of marine engineering. Further particulars may be obtained from the Secretary, Institute of Marine Engineers, The Minories, London, E. 1.